# AIR ENGINEERING

NOVEMBER, 1960

AIR POLLUTION CONTROL • AIR MOVING • AIR CONDITIONING

THE UNIVERSITY OF MICHIGAN
NOV 9 1960
ENGINEERING

*Ways To Reclaim Heat In Factories*

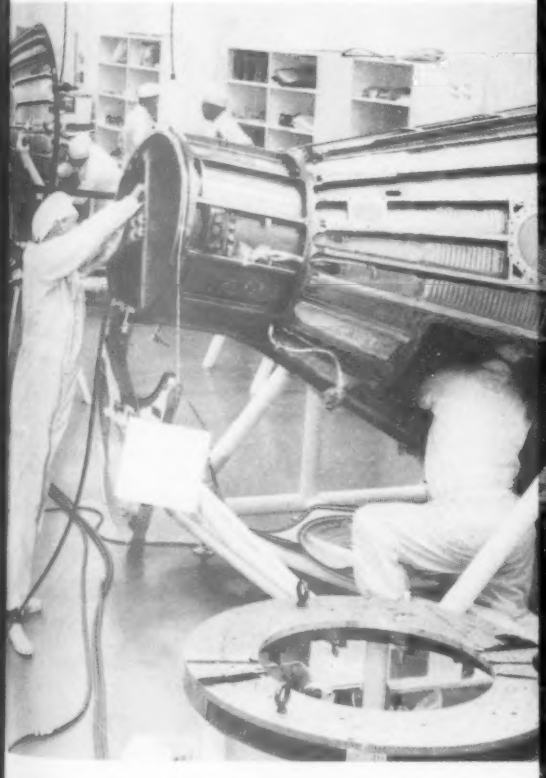
*Practical Methods Of Ventilating Pressure Filters*

*Helpful Specs On Environmental Control In A Semiconductor Plant*

*New Type Wet Scrubber . . . Its Applications And Operation*

*How To Sanitize Air In Air Conditioning Systems . . . Part II*

*Tips On Dust Collection In Woodworking Plants*

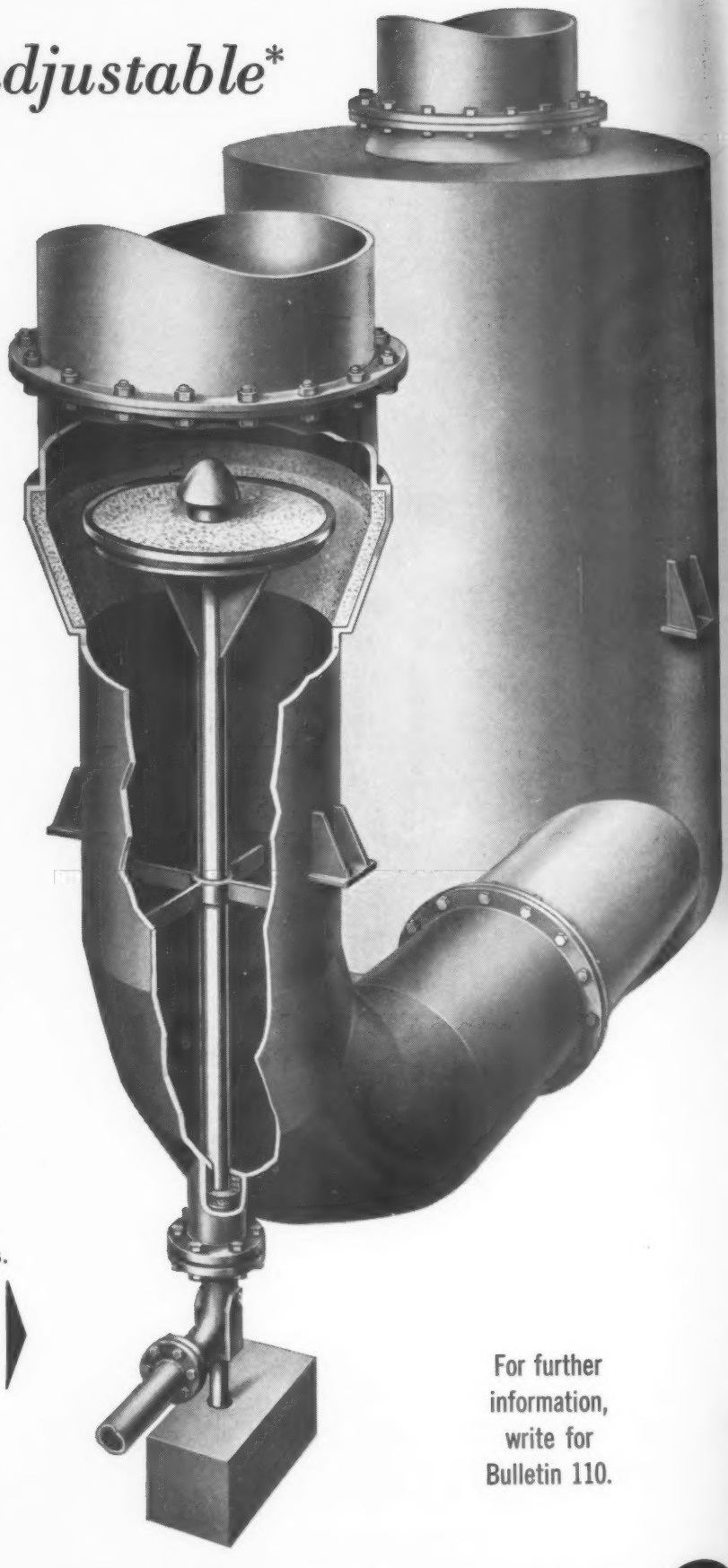


**About White Rooms for Project Mercury . . . p. 28**

*Completely adjustable**

# Flooded Disc Scrubber

## Removes Sub-Micron Fumes



The Research-Cottrell high efficiency scrubber uses the unique flooded disc principle for removing sub-micron fumes in steel-making furnaces and chemical processing.

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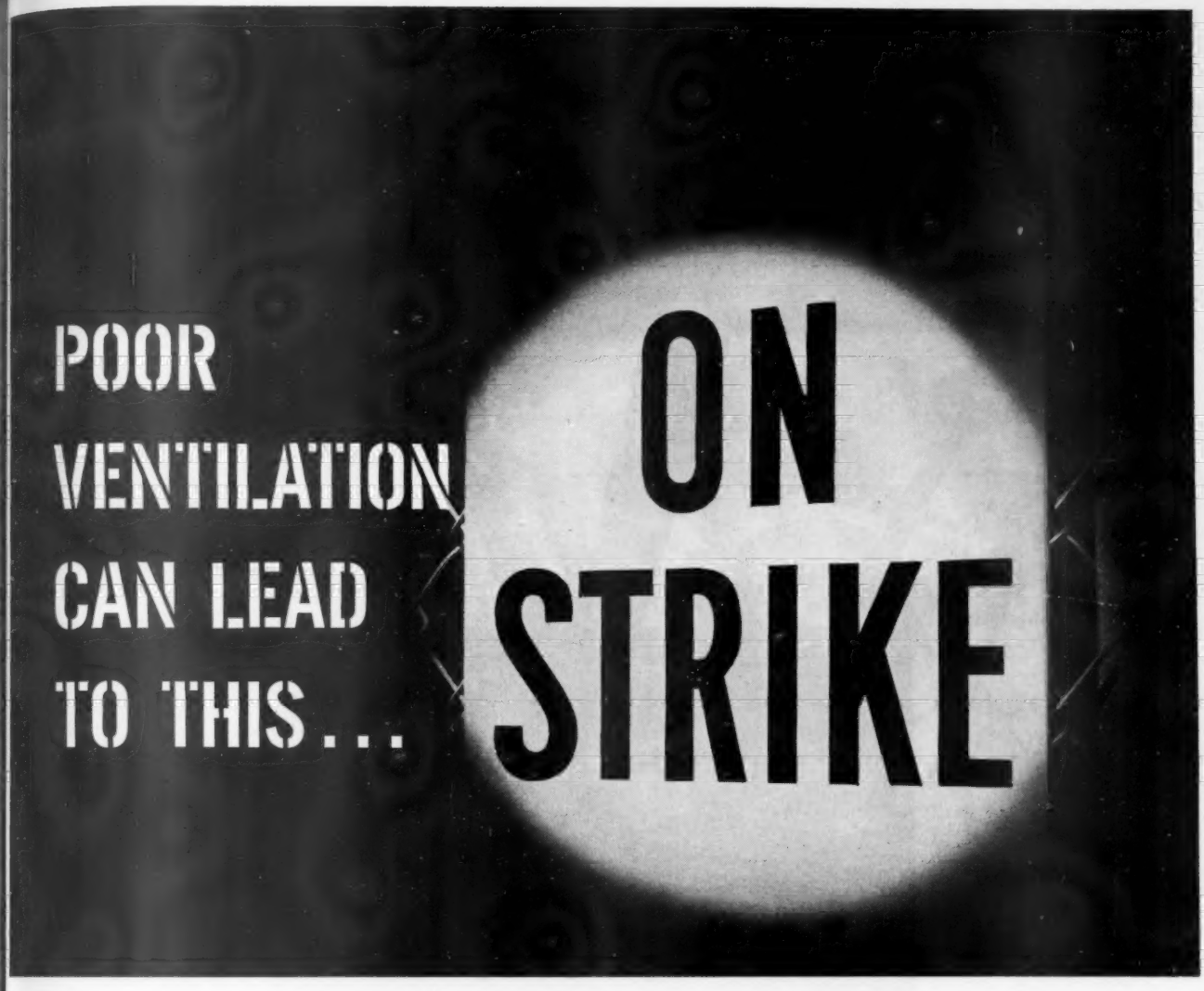


# Hartzell ventilation can help prevent it

Bad ventilation is seldom the sole cause of a labor dispute, but it's often a contributing factor. Unpleasant working conditions are bad for morale. Smoke, heat and fumes cause discomfort . . . and discomfort breeds discontent.

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**here's a complete line of air moving equipment designed and built specifically for industry**

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YOU CAN BE SURE . . . IF IT'S **Westinghouse**

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# AIR ENGINEERING

VOL. 2, NO. 11

NOVEMBER, 1960

DEDICATED TO THE SCIENCE OF AIR POLLUTION CONTROL
AIR MOVING • AIR CONDITIONING


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*William Andresen, chief industrial hygienist, American Cyanamid Co., gives factual data on hood design.*

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# SPENCER Vacuum

Assembly and Gaging Dept., Miniature Precision Bearings, Inc., Keene, N. H.

## KEEPS "WHITE ROOMS" WHITE

Dirt and dust are strictly bad news around gaging or assembly areas of a company producing precision ball bearings. Every possible precaution must be taken to assure an absolutely dust-free atmosphere in the "white rooms".

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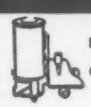


PORTABLE VACUUM CLEANERS

PNEUMATIC CONVEYING SYSTEMS

BLOWERS


# Letters

## Safety Engineer Comments On September Editorial

Editor:

Your editorial on the September issue of AIR ENGINEERING is most interesting and most timely. There is no question that more design engineers in their regular work as well as production engineering personnel need to consult with individuals in other disciplines to make sure that there is no area of problem which has been overlooked. The example which you have described in some detail in this editorial is a perfect one.

In line with your comment it would seem to me quite appropriate to offer an additional thought right along the same lines as your editorial. The number of industrial hygienists who are in industry is relatively small. It takes a substantially sized organization which is engaged in a field involving many and varied chemicals to justify the employment on a full time basis of a person with this highly specialized area of knowledge. On the other hand there are a far greater number of establishments who do employ full time safety directors or safety engineers to act as staff specialist in this highly important area of preventing all kinds of injuries to their employees including those involving toxic substances.

### Safety Engineer Consultation

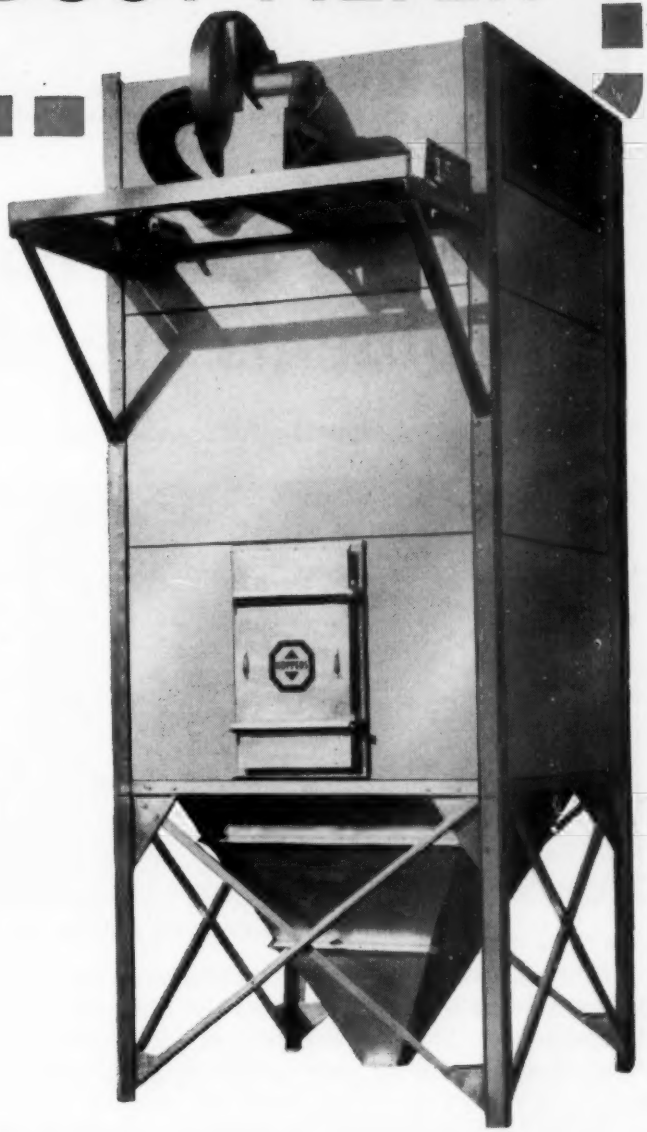
This safety director or safety engineer, as his title may vary within organizations, has a familiarity with many types of hazards including those that might be the result of the use of chemicals and is trained to know when to call in the specialist if a substance may prove to be hazardous. Thus, I would urge to your readers who are engaged in design or production work, particularly on new operations or new structures that they make sure they have consulted with the safety director or safety engineer in the establishment because the probabilities are high that there will be one of these persons who has a specialized area of knowledge available where there probably will not be an industrial hygienist.

Furthermore, consultation with

*(Please turn to page 6)*

Reverse-air jet filtering comes of age with the

# NEW KOPPERS MODEL K AEROTURN® DUST FILTER



## *NEW PERFORMANCE*

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## *NEW ECONOMY*

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## *NEW FEATURES*

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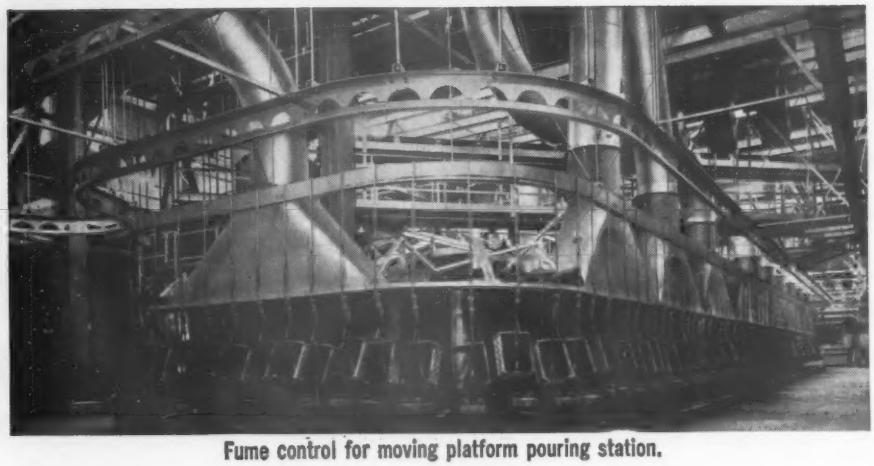
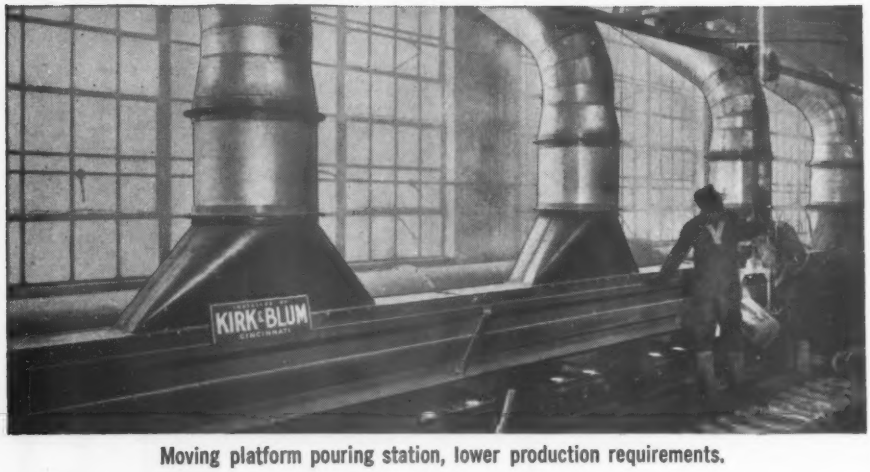


Fume control for moving platform pouring station.

# No two fume control problems are alike!




Moving platform pouring station, lower production requirements.

Since no two fume control problems are alike, a Kirk and Blum engineering survey determines the exact nature of *your* specific application. It's all part of K & B's *complete* service to assure you the best system for your particular need, all factors considered.

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*Complete Fume and Dust Control Systems*

# Letters

*(Continued from page 4)*

the safety director would result in having him focus attention on not only hazards from chemical sources which might be removed by more adequate ventilation but also hazards from processes, equipment, layout and other aspects of the operation with which the design engineer may not be familiar because of his specialized knowledge in the area of design of that particular type of system.

There is no question but what the increasing complexities of our industrial systems and organizations today, are such that it has become more and more important that there be specialists within these various areas who, by spending their time and efforts studying in these specialized areas and when working together can create a safe place for people to work and to prevent injuries rather than to merely rectify them after they have occurred.

### Purpose of Society

Our Society is composed of over 7,000 safety engineers and safety directors and safety specialists throughout the entire fifty states as well as some overseas, and one of our purposes is to help disseminate information to our members as well as to the public on the best means of preventing injuries to people. We hearily concur on the philosophy of your September, 1960, editorial and urge that it be extended even further to bring into the picture the individual who is far more frequently found in an individual plant, namely the safety director or the safety engineer.

*A. C. Blackman*
*American Society of Safety Engineers*

### Likes School Commentary

Editor:

I would like to compliment AIR ENGINEERING on the editorial on air conditioned schools.

It is about time the nation took some steps to increase the efficiency of our school system by using schools for the full year and by cutting down the increasing tax burden which additional schools force upon the tax payer.

*Geo. E. Mills,*
*Air-Conditioning & Refrigeration Institute*

# AIR ENGINEERING

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**EDITORIAL:**

## *How Air Pollution Control Can Help You . . .*

YOUR CITY'S AIR POLLUTION control officer can be an extremely useful adjunct to your own operations, if you know how to use his services.

The qualified air pollution control officer is trained in combustion, meteorology, dust collection, stack sampling, dust collection techniques. He generally has a staff of engineers, chemists and an impressive array of portable and permanent instrumentation to back him up.

He's not there to police you as much as he is to help you with pollution problems, safeguard your investment in dust collection equipment and to protect you if you are *not* to blame for the pollution others are trying to pin on you.

Manufacturers of dust collection equipment are well aware of the influence air pollution control officers have, through their advice and counsel, on air pollution abatement equipment selection. At the various national and regional air pollution meetings and seminars, suppliers take great care to see that pollution control people attending are right up-to-date on latest equipment. Manufacturers' sales representatives keep local air pollution control officials informed of their latest equipment and processes.

Then too, the air pollution officer is in a unique position to know what is going on in all of the factories in his area, and he is in constant contact with his counterparts in all of the larger cities.

Your municipal APC man has a broad knowledge of industrial processes and their dust collection problems. As a public servant, this knowledge is available to help you solve your own air pollution and allied dust collection, odor and noise problems.

Air pollution abatement procedures are, as you know, complex, tricky and costly. You need to know how to figure dust loadings, how to take accurate stack samplings, how to analyze your pollutants.

There's many a pilot plant study we know of going on right now, in which the local control officer is the key figure. A frequent practice is to use a smaller plant in the city to test out a device that could solve the same and more severe problem in a larger plant. Once the air pollution officer knows

*(Please turn to following page)*

## Editorial (Cont.)

*(Continued from preceding page)*

the solution, he is more than willing to help you apply it to your operation.

You need not live in Los Angeles or San Francisco to have a high level air pollution control department to help you out. Smaller cities have air pollution people with considerable ingenuity. Cincinnati's air pollution control chief, Charles Gruber, for example, has come up with a unique odor analyser which pinpoints odor sources right down to the point of emission, determines the degree of odor level, and helps end quarrels as to which plant is the offender.

In Detroit, air pollution chief Morton Sterling, a combustion engineer himself, spends considerable time advising and consulting with air engineers in local industry. Ben Linsky, of the San Francisco Bay Area Air Pollution Control District, has as his basic philosophy that it is far better to persuade, with technical assistance, than to enforce with legal clubs.

Wright Erion, Columbus, Ohio's air pollution chief, has just bought a one-man portable air testing laboratory. Management of local plants have, says Erion, exhibited a great deal of interest in his equipment, and in results of his tests with it.

If your incinerator is smoking, your power plant belches plumes at the wrong end of the Ringelmann scale, your air pollution officer can help train your operating personnel in the correct method of firing equipment.

Detroit's air pollution control department has about $5000.00 invested in noise analysis equipment, has helped local industry spot the source of their noise problems and to come up with their solutions.

Area residents aren't the only complainers about air pollution. You yourself may have a complaint. A lumber mill in Wisconsin found that freshly planed millwork, and white lumber, was being soiled by black sooty particles. The air pollution control department was able to track these pollutants to a nearby school building. It was found that the heating plant in the school was not only old, but that the school fireman did not know how to fire it properly to achieve maximum combustion to eliminate the sootfall.

We urge you, also, to take an active part in community air pollution control abatement practices. Get on the city's air pollution control advisory committee. Make sure that proposed abatement legislation is practical. Use this opportunity to protect yourself against the fanatic "do-good" sect who would have your management hock their plant right now for pollution abatement equipment that might not work.

If your city does not have a trained air pollution control officer, chances are its air pollution control ordinances are archaic, impractical and therefore potentially dangerous for you.

You're far safer with workable air pollution ordinances based on practical abatement techniques, with grandfather clauses that give you time to comply. You're far safer with a trained, sympathetic air pollution control officer to help you meet these legal requirements.

If all you have are ill-defined "nuisance" regulations, you're a sitting duck for lawsuits. Get out and help your city put over workable pollution laws, see that they hire a trained man to implement them, and you'll be money and time ahead!

Eugene A. Sloane

Editor

## Meetings, Courses, Expositions

**National Warm Air Heating and Air Conditioning Assoc., Statler-Hilton Hotel, *Cleveland, Nov. 14-17.***

**Occupational Health Seminars, Wayne State U. College of Medicine, *Detroit, "Environmental Heat Stress In Industry" (Nov. 14); "Current Status of Airborne Ions—Health Relationships" (Nov. 28).***

**Building Research Institute Fall Conference, *Shoreham hotel, Washington, D. C., Nov. 15-17.***

**Mid-Atlantic States Section Meeting, *Consolidated Edison Co., New York, Nov. 17.***

**Air-Conditioning and Refrigeration Institute annual meeting, *Hollywood Beach hotel, Hollywood Beach, Fla., Nov. 18-22.***

**Refrigeration and Air Conditioning Contractors Association convention, *Fontainebleau hotel, Miami Beach, Fla., Nov. 20-23.***

**National Assoc., of Practical Refrigerating Engineers, Incorp., Sheraton-Jefferson Hotel, *St. Louis, Missouri, Dec. 1-2.***

**Heat Transfer Division, ASME, 1960 Winter Annual Meeting, *Statler Hilton Hotel, New York City, Nov. 27-Dec. 2.***

**24th National Exposition of Power & Mechanical Engineering, *New York Coliseum, New York City, Nov. 28-Dec. 2.***

**Institute of Industrial Medicine, *New York-U. & Bellevue Medical Center: Course in Air Pollution, Nov. 28-Dec. 9.***

**Sixth Industrial Hygiene and Air Pollution Conference on New Environmental Problems in The Construction Industry, *The University of Texas, Austin, Texas, Dec. 3.***

**First Industrial Building Exposition & Congress, *Coliseum, New York City, Dec. 12-15.***

**At Robert A. Taft Sanitary Engineering Center, Cincinnati. Course in Medical and Biological Aspects of Air Pollution, *Dec. 12-16.***

**Industrial Heating Equipment Association, Inc. meeting, *Dearborn Inn, Dearborn, Mich., Jan. 23-24, 1961.***

**American Society of Heating, Refrigerating, and Air-Conditioning Engineers semi-annual meeting and exposition, *International Amphitheatre, Chicago, Feb. 13-16, 1961.***

# BLAST FURNACE GAS WASHING

***Chemico P-A Venturi washers selected for 36 installations at 20 separate plants...***

In furnaces from coast to coast, the Chemico P-A Venturi washer is proving the single most economical and effective method of cleaning blast furnace gases. Prior to the introduction of the Venturi blast furnace washer, the dust content of the gas from conventional primary washers ranged from 0.15 to 0.35 grains/CF. The Venturi washer can achieve results as low as 0.005 grains/CF.

Low initial cost, inexpensive installation and virtually no maintenance are the more obvious economic advantages of Venturi blast furnace washers. In addition, however, Chemico Venturi washers require very little water—one-third as much as conventional washers—and permit complete recycle.

They are rugged units which have proved their reliability and long life in actual working furnaces. Also important is their ability to handle wide fluctuations in gas volume without sacrificing cleaning efficiency. With 36 units now in operation or on order, you can be certain of proven performance with a Chemico P-A Venturi washer.

If you are considering the installation of gas cleaning equipment in a blast furnace, a Chemico representative would be pleased to show you the kind of top-performance job you can expect from a Venturi washer. And remember, Chemico handles the complete job... PLANNING, DESIGN, ENGINEERING, ERECTION and START-UP.

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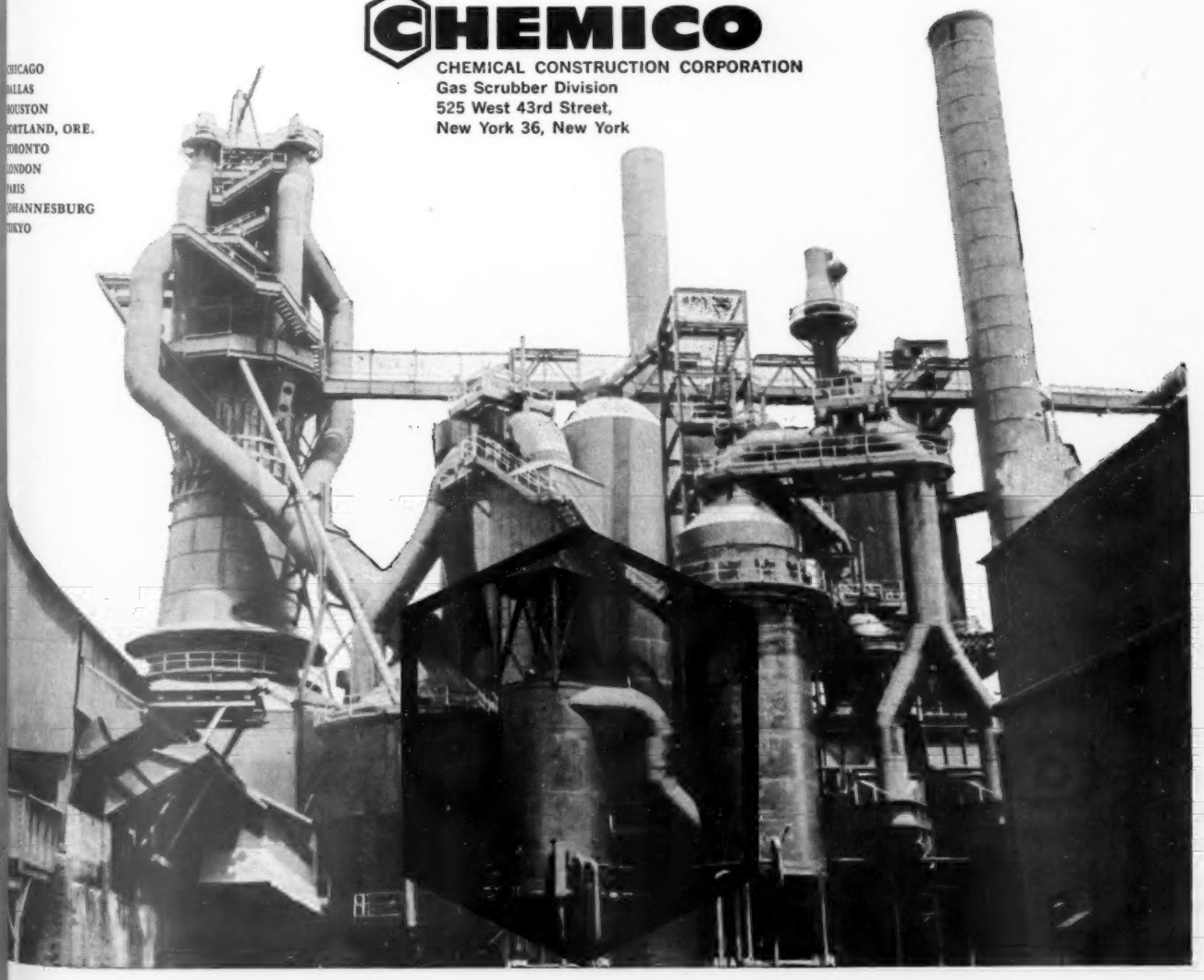

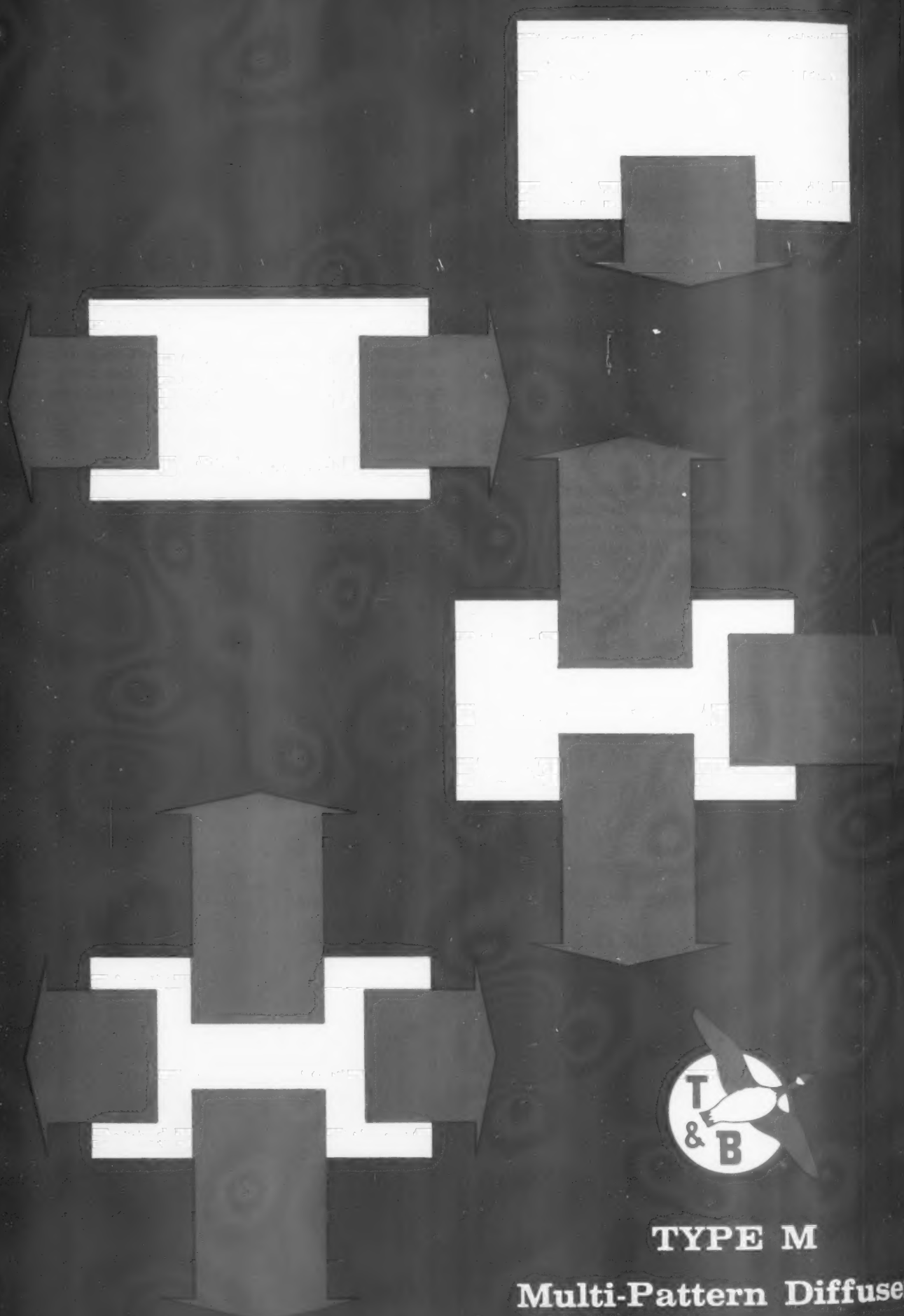

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# *The extreme flexibility of* **Type M Multi-Pattern Diffusers** *means custom-selected air distribution*

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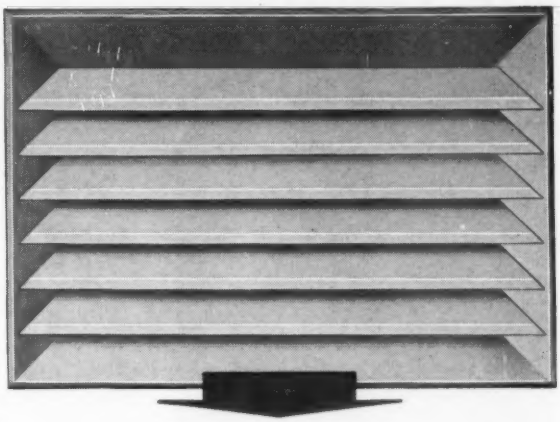

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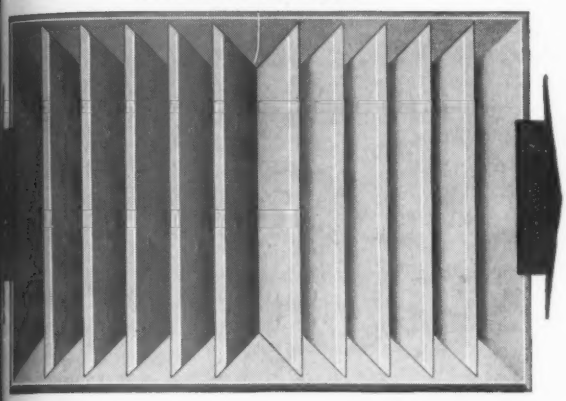

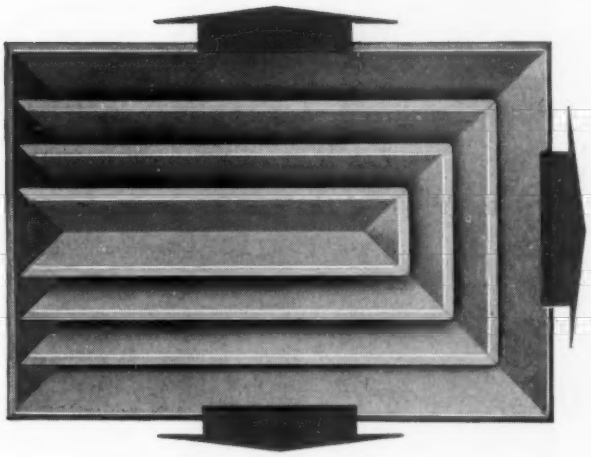

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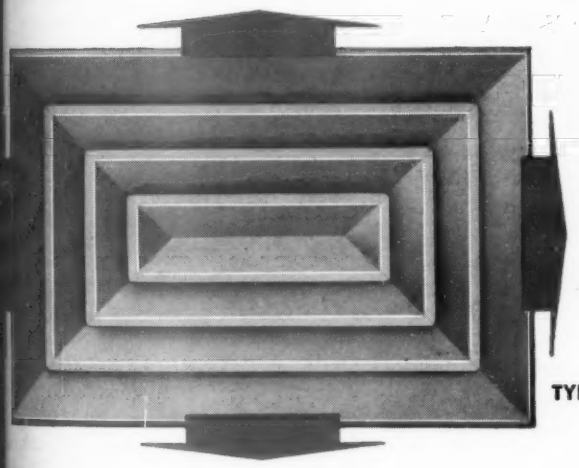

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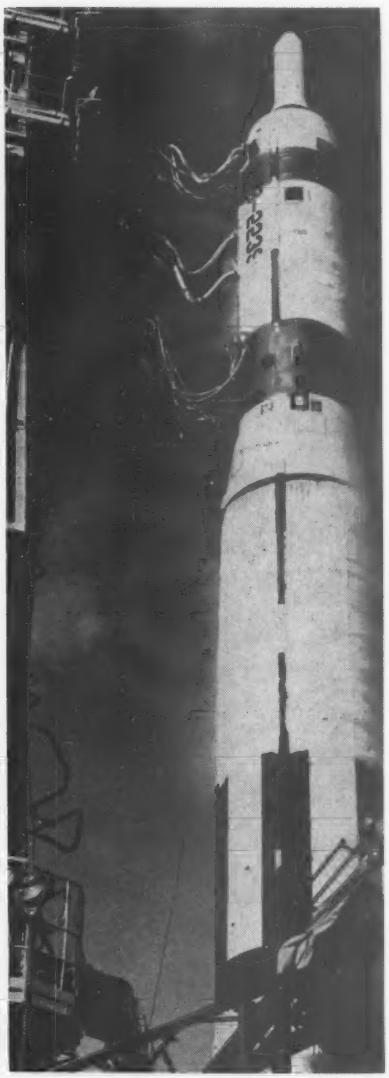
# NEWS of the Industry

*A Special Report . . .*

## Air Conditioning At Florida's Cape Canaveral Center



*←Air conditioning plays an important and vital role in keeping such complicated missiles as the Titan in perfect performing shape. Without conditioning, the missile would not be able to leave the ground.*

A special report from the Air Force Missile Test Center at Cape Canaveral, Fla. shows that air conditioning may well be the backbone of the Center. Indeed, some missiles such as the *Titan* would not be able to get off the ground without it.

Data on equipment lists some 850 air conditioning units totaling approximately 6,700 tons capacity at the launching areas, plus another 650 tons of refrigeration. This equipment is installed just on the 15,000-acre cape, known officially as *Cape Canaveral Missile Test Annex*. How much more air conditioning is involved in the rest of the Test Center might be difficult to determine.

Operations requiring air conditioning at the site are: industrial area, missiles, launching pad, blockhouse (control structure), central control ("nerve" center), "azusa" (electronic tracking system), and telemetry (recording) station.

Primary purpose of almost all the air conditioning in the Test Center is to cool and dehumidify air for the electronic equipment, both on the ground and in such complicated missiles as the *Titan,* although with the latter it's also required to protect parts of the "bird" from damage to excessive cooling when it's being fueled with "lox" (liquid oxygen) at -297°F.

Air conditioning is essential for the *Titan,* a huge two-stage missile 98 ft. long, weighing 110 tons when fully fueled. Combined thrust of both stages is 380,000 lbs., and the range is said to be more than 8,000 miles. Conditioned air is required for three compartments of the *Titan:* the guidance bay, the telemetry bay, and the "sustainer" or second-stage engine compartment.

## *Engineer Claims Cell Reduces Smog*

A Milwaukee scientist-engineer, Richard Drushella, believes that smokeless and smogless cities may soon become a reality, thanks to a new power source. Drushella, at a recent meeting of the Society of Petroleum Engineers, discussed the history of a fuel cell, as well as future commercial application of the device, which converts chemical energy directly into electrical energy.

The fuel cell, developed by Allis-Chalmers, uses a mixture of gases including propane and oxygen. Under commercially available pressure, the mixture is fed into the cells. Chemical reaction in the cells causes a flow of direct current to an electric motor which may drive a vehicle or power a tractor.

According to Drushella, the fuel cell can deliver energy at 90 percent efficiency.

## Advance Smog Warnings

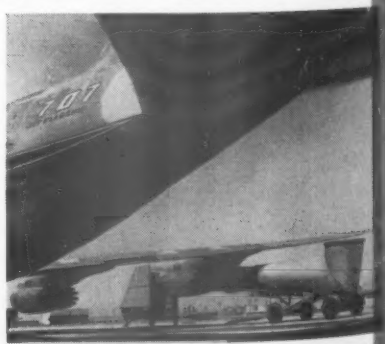
Advance warning of impending severe smog conditions is now available to all cities east of the Rocky Mountains, under a new cooperative network operated by the Weather Bureau. Thirty-six states will be able to receive warning bulletins, called *Stagnation Bulletins,* by teletype from the Bureau's Research Station in Cincinnati.

The Bulletins will be distributed through local weather stations and offered, normally, only to air pollution control officials and representatives of industry, to inform them of weather conditions likely to contribute to the build-up of high levels of air pollution.

Interested agencies or groups are requested to contact the Meteorologist-in-Charge at their nearest Bureau station.

## New Noise Suppression Unit

A new series of portable noise suppression systems for jet aircraft has been developed by the General Acoustic Corp. of Los Angeles. The suppressor systems consisting of noise control units for jet engine intake and exhaust reduce noise levels 10 to 25 decibels at distances of 250 ft. Units set on four rubber-tired, castered wheels, have special brakes.



*(Please turn to page 14)*

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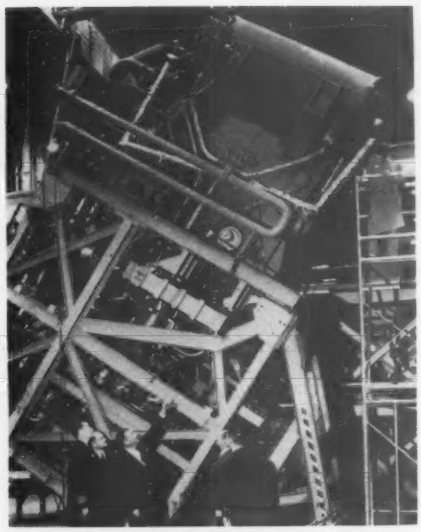
# NEWS of the Industry . . .

*(Continued from page 12)*

## Carrier Corp. Launches Sub Cooling Unit



*Simulated seaworthy trial of Carrier's new steam-operated cooling machine for the attack submarine Pollack is witnessed by Navy officials. While pitched at 30 degrees, the unit continues to provide chilled water for air conditioning.*

A new type cooling machine for use in air conditioning the attack submarine *Pollack* has been developed by Carrier Corp. and shipped to the New York Shipbuilding Corp. at Camden, N. J.

The unit, one of 21 Carrier is building for the Navy, uses steam from the submarine's nuclear reactor, eliminating the need for extra electric generating equipment.

Russell Gray, president of the company, reports that the unit is "far quieter than piston-type cooling machines, due to its lack of moving parts." Improvements in anti-submarine weapons, such as sonar and sound-seeking missiles have made this type of unit essential for the newer submarines, he added.

The new cooler will produce capacities ranging from 100 to 200 tons, depending on fluctuating operating conditions, and will handle the heat generated by *Pollack's* 88-man crew, operating machinery and cooking and laundry facilities. It is capable of withstanding high shock resulting from depth charges or recoil after missile-firing.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### *Air Pollution Legislation*

● *Chicago*—In the opinion of State Rep. Paul J. Randolph, the failure or inability of the city to control AP calls for drastic action. "They have home rule—the power to clean up Chicago's air—and what have they done about it?" Randolph stated. "The answer is not very much."

Randolph said he probably will urge the renewal of a 1959 AP recommendation which calls for a separate commission to be created by legislature to survey the whole problem. "It is obvious that the air pollution problem is more than a city problem," he said. "It goes beyond city and state boundaries."

● *Cincinnati*—Ohio Valley AP Control Council has postponed a proposed survey of nine Ohio and West Virginia counties until next spring. A spokesman for the U.S.P.H.'s sanitary engineering center said the reason was the reluctance of old council members to commit funds for the survey to new members.

● *Cleveland*—As the result of an additional one-year grant from U.S.P.H., the study of AP control will be expanded at Case Institute of Technology. The grant adds $23,000 to the $47,995 given during the past two years, and will enable Dr. Seymour Calvert, associate professor of chemical engineering to continue his basic study of AP wet scrubbers.

● *Denver, Colo.*—Members of a City Council committee have urged a greatly stepped-up program to combat smog. The committee studied recommendations included in a 24-page report developed by the Council's research analyst. Should this plan be adopted, it would mean increased expenditures for AP control from $6,600 to at least $45,000 a year.

● *East Rutherford, N. J.*—Stricter AP controls are planned by the Board of Health, based on information supplied by New York City AP experts. New ordinance will include specific standards. Preliminary meetings have been held with area companies and the Board in an attempt to eliminate smoke and odor problems.

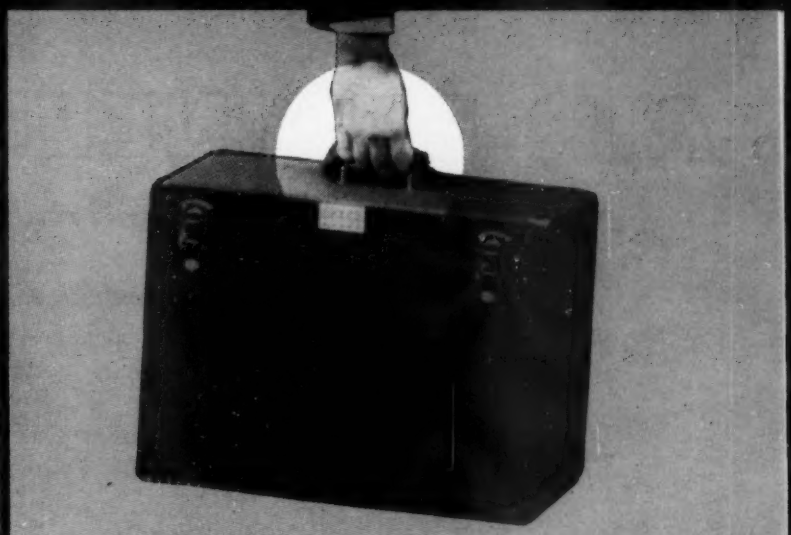
● *Harrisburg, Ohio* — An attempt at statewide control of AP has been throttled by a powerful Senate check on appointments by Gov. David L. Lawrence. Under legislation approved in 1959, the governor is empowered to name a six-member majority on the 11-man AP Control Commission. The law was signed last January and appointments submitted in June. Since then, the names have been locked in the chamber's Executive Nominations Committee. Reasons for the block are not clear.

"There are no objections to the individuals," caucus chairman Sen. Robert D. Fleming stated. "They object that all segments of industry are not represented."

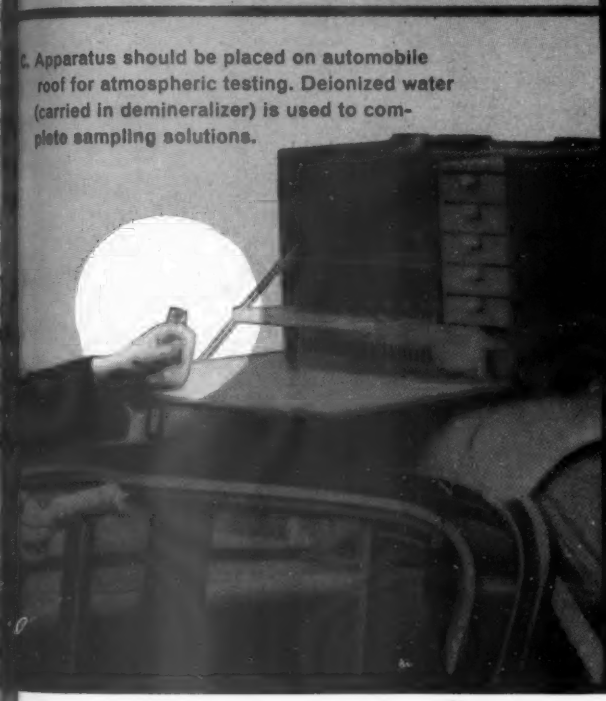
● *Milwaukee* — A resolution drafted last month by County Board supervisor Donald F. Weber calls for an investigation of the county's AP program. The measure provides for hearings before the Board's highway committee.

*(Please turn to page 48)*

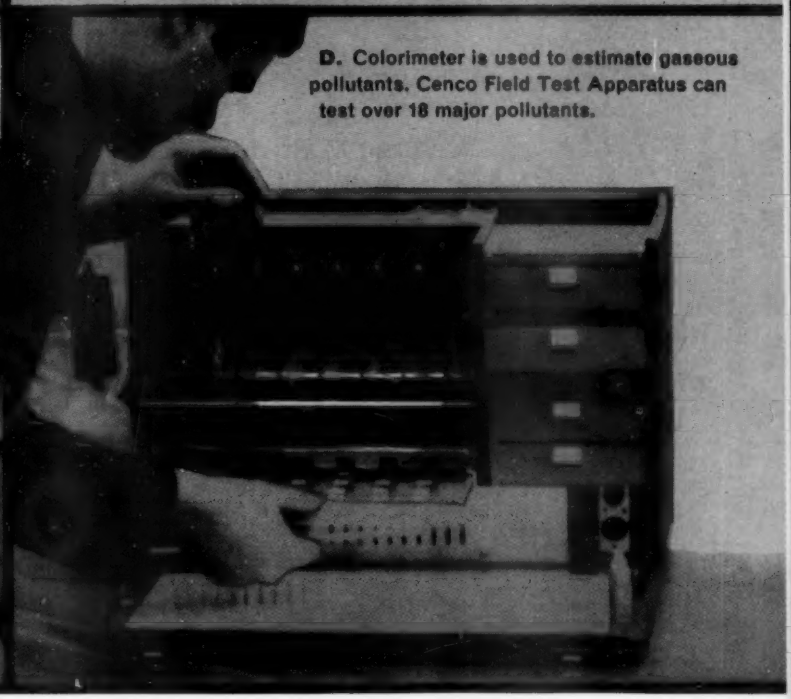
A. Air Pollution Apparatus ready for survey. Illuminated filter slide permits direct, quantitative determination of gaseous pollutants.



B. Lightweight, compact design makes it easy to transport to test site. Even untrained personnel can make initial studies with the Cenco Test Apparatus.



C. Apparatus should be placed on automobile roof for atmospheric testing. Deionized water (carried in demineralizer) is used to complete sampling solutions.



D. Colorimeter is used to estimate gaseous pollutants. Cenco Field Test Apparatus can test over 18 major pollutants.

# EW AIR POLLUTION FIELD TEST APPARATUS

You can make on-the-spot surveys of 18 major pollutants in just minutes. This new Air Pollution Test Apparatus is ideal for detection where fast accurate information is needed. It can also be used to make initial studies of previously unsurveyed areas prior to the setting up of a monitoring program. Trained personnel are not required for operation. The Field Test Apparatus is portable, lightweight and easy to set up and use. It was developed by Kem-Tech Laboratories, Inc. of Baton Rouge, La., for the U. S. Department of Health, Education and Welfare. For details, write for Booklet 313.

No. 20770 **$595.00**

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### *For Hot Spots . . . Air Conditioned Clothing*

For industrial hot spots and similar applications, a patent has been granted for clothing with built-in thermo-electric cooling points. Clothing is not yet in production.

---

### *Plastic Heat Exchangers In Research Phase*

A plastic firm has come up with the idea of using plastic for heat exchangers. Plastic costs cents instead of dollars per square foot. Although its heat conductivity factors are of course far lower than metal, where space permits, plastic heat exchangers can be made with larger surface areas to come up with equivalent heat transfer. Use is expected to be limited to applications where pressures on both sides of the heat exchanger are about equal.

---

### *Complete Industrial Air Service Featured At Power Show*

Among the hundreds of exhibits at the 24th National Exposition of Power and Mechanical Engineering, Nov. 28-Dec. 2, N. Y. Coliseum, New York City, N. Y., will be a complete industrial air service that includes factory air conditioning, air pollution control, air and gas handling and movement of dry materials by forced air.

A new instrument to be shown will measure as low as 1 to 20 parts per million of oxygen in other gases. This instrument also comes with a stainless steel regulator for measurement of total impurities of less than 10 ppm.

---

### *Large Industrial Air Conditioning Market Seen*

"The broadest areas of prospective growth are those in which economic benefits justify the investment," said Cloud Wampler, Carrier Corp., president.

Writing as the guest editorialist in the *New York Herald Tribune*, Mr. Wampler stated that the nation's industrial air conditioning market remains virtually untapped. Only 3 percent of the 6.1 billion sq. ft. of enclosed industrial space, housing 12 million workers, is air conditioned, he stated.

Speaking of hospitals, Mr. Wampler said that air conditioning helps increase hospital census during summer months, to defray fixed expenses, and that only 13 percent of all floor space in all hospitals is air conditioned.

Quoting from the U. S. General Services Administration survey of air conditioning as related to employee efficiency, Mr. Wampler said that only a seven-minute savings per day per employee (or 1.5%/year) will more than pay for the expense of air conditioning.

---

### *AEC Charged With Hoarding Uranium Dust Collection Techniques*

The Uranium Institute of America has charged the Grand Junction, Colo., operations office of the Atomic Energy Commission with withholding secret data on uranium dust collection procedures.

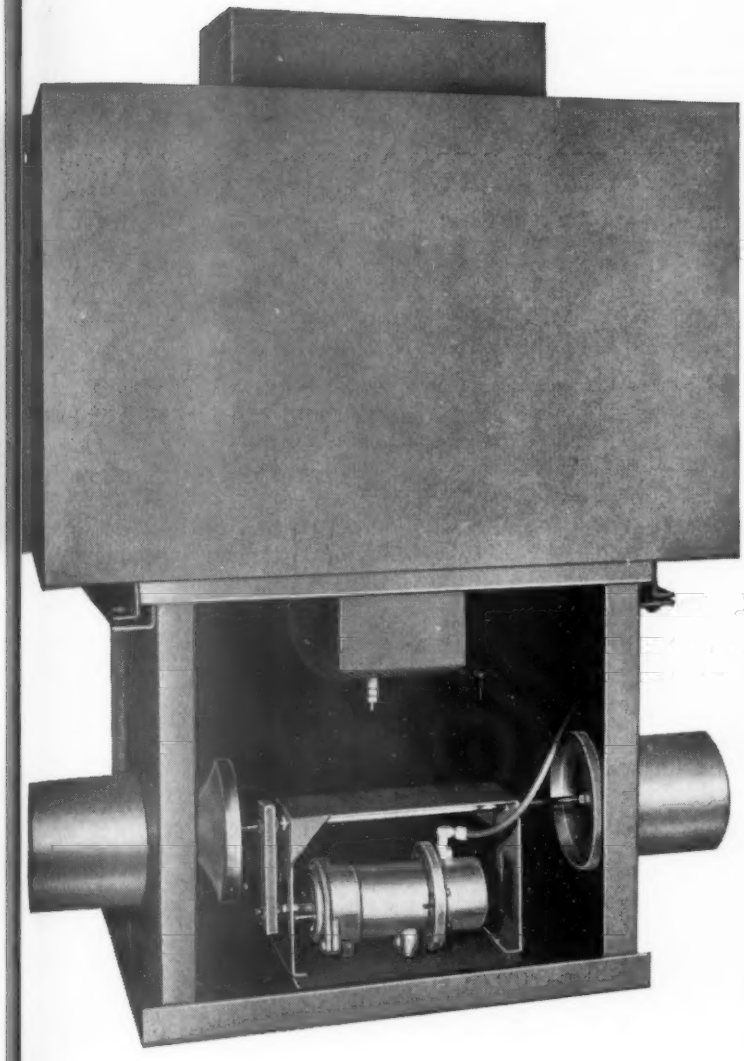
The uranium producer's group charged that the AEC is holding back on dust collection methods that would permit sizeable sums to be realized through product collection.

---

### *Bureau Of Mines Declares "Germ Warfare" On Smokestack Sulphur*

Bacteria that will be able to "eat" sulphur out of gases in industrial smokestacks are being tested by the Bureau of Mines in Pittsburgh. Bacteria are being tested on various types of coals. Commercial applications are foreseen.

# ALL NEW AGITAIR® MIXING BOXES



## A MAJOR DEVELOPMENT IN CONSTANT CONTROL AND DISTRIBUTION OF HIGH VELOCITY TEMPERED AIR

A simple design of the all new AGITAIR Type "O" series, high velocity mixing boxes eliminates all troublesome linkages and pivots. Only one motor is employed to operate the inlet valves which are driven directly, guaranteeing instantaneous response with no lost motion or backlash.

The mixing valves proportion the hot and cold air in response to the room thermostat and the unique AGITROL volume regulator guarantees constant control of air delivery at the required volume.

Comprehensive noise attenuation tests were conducted to assure extremely low sound ratings for ceiling and under the window units. And for noiseless, draftless distribution of the conditioned air from these units, there is a complete line of AGITAIR diffusers and grilles from which to choose.

Technical catalog HV-100 contains complete performance data and dimensions on all AGITAIR units. Write for your copy today.

## FEATURES

1. One motor — no linkages.
2. Aluminum inlet valves driven directly — instantaneous response . . . no lost motion . . . no backlash.
3. Unique AGITROL valve (constant volume regulator) actuated solely by the supply air.
4. Both mixing and attenuation chambers fabricated of galvanized or galvannealed steel . . . sealed to prevent air leakage.
5. Split fabrication of attenuation chamber permits dimension adaptation to meet most space limitations.

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*BETTER PRODUCTS FOR*
*AIR DISTRIBUTION • AIR CLEANING • AIR EXHAUST*

# *New* PRODUCTS

## RF Radiation Protective Suit

*Purpose:* Claimed to afford complete protection from the harmful biological effects of electro-magnetic radiation.

*Features:* New, one-piece garment has a shielding effectiveness of 50 db over a frequency range of 30 mc to 1000 mc, and is arc resistant to a potential up to 4000 volts. Permits continuous operation during necessary inspection, repair and maintenance in high level radar fields.

Tests have shown the protective suit can be safely worn in areas where the RF level is 10,000 times greater than the USAF maximum safe limit of 10 milliwatts/sq. cm. Consisting of four layers of material, and with a patented safety lock closure to maintain positive shielding integrity, the suit will remain pliant and flexible down to -40°F.

*Source:* Engineering Division, Filtron Co., Inc., Dept. AE-11, Flushing, N. Y.

## Hi-Flow Tape Air Sampler

*Purpose:* To provide versatility in sampling atmospheric particulate matter.

*Features:* Flow rates measured by pressure drop across filter (measured on vacuum gauge). Spiral-loading cartridge on take up side permits sample spots to remain intact and undisturbed because of no over-lay. Spiral length of tape in cartridge is approximately 52 in. Tape supply spool holds 100 ft rolls, equal to approximately 23 cartridge loadings each having 60 sample spots.

Timing mechanism automatically controls sampling time and moves tape to new spot. Sampling periods of 0-30 hours marked in ½ hour intervals, 30 second time lapse between indexing of spots. 15 in. x 19 in., weight 50 lbs. Price $605 with 100 ft tape, f.o.b.

*Source:* Research Appliance Co., Dept AE, P.O. Box 307, Allison Park, Pa.

## New Conversion Unit

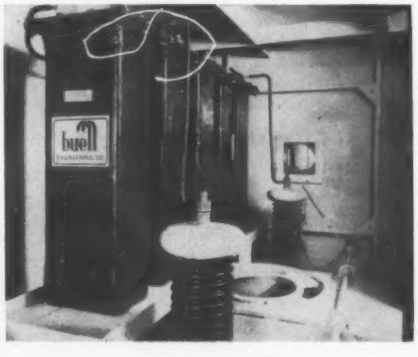
*Purpose:* Maintenance-free silicon rectifier designed for electrostatic precipitators.

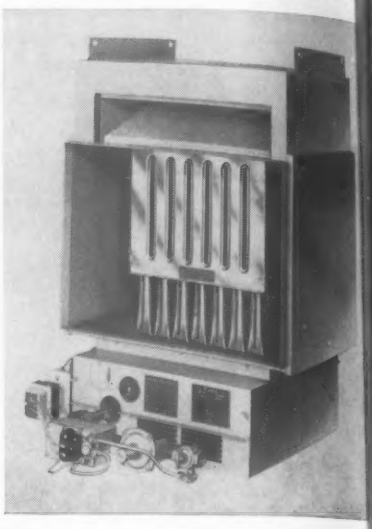
*Features:* Costs about ⅓ of a complete new power pack. Utilizes all existing equipment with the exception of the rectifier motor, disc, shoes, suppressor elements and pedestal. Ties in with present AC connections, and also with the DC switchgear which distributes the rectified power.

Silicon rectifier has no moving parts and its electrical efficiency is claimed by manufacturer to be approximately 25 percent greater than the mechanical type. Complete replacement can be accomplished in six to eight man hours.

New rectifier is made up of four independent rectifier units, and has a choke in the output line to protect the rectifier from high voltage feedbacks. Each of four rectifier units comprises two racks of silicon diodes immersed in an insulated container of dielectric fluid.

*Source:* Buell Engineering Co., Inc., Dept. AE-11, 123 William St., New York.





## Downstream Duct Furnaces

*Purpose:* For use downstream of cooling surface in air conditioning systems.

*Features:* Built-in by-pass offered as standard equipment said to eliminate need and expense of adding separate by-pass duct to handle the greater cfm required by systems providing cooling. As a result, all air passes through the duct furnace, reducing internal static pressure.

Burners are stainless steel; heat exchangers are either stainless or aluminum steel; casings are aluminized steel. Furnaces may be installed side by side in unlimited numbers with any one of three height groupings.

Six sizes ranging from 75,000 to 300,000 Btu/hr input. All models are A.G.A. approved for use on natural, mixed or LP gases. Controls are designed for 24-volt service and can be converted to 155 v and 230 v operation by means of optional transformer.

*Source:* Modine Manufacturing Co., Dept. AE-11, 1500 DeKoven Ave., Racine, Wisc.

## Temperature Controller

*Purpose:* To compensate for humidity rise by lowering dry bulb temperature automatically.

*Features:* Combines thermostat and humidistat: the thermostat begins compressor operation as if the thermostat setting were two or three degrees below its setting.

*Source:* Chrysler Airtemp., Dept. AE, P.O. Box 1037, Dayton 1, Ohio.

*(Please turn to page 22)*

## Clean Floors Begin at Your Doors with "the miracle mat"

# ON GUARD AGAINST WALK-IN DIRT!

Dust, dirt, and grime can't invade your clean room when workers gain entry across a MIRACLE MAT! The instant feet touch the MIRACLE MAT'S attractive floor grille, thousands of tough bristles go to work . . . whisking dirt from soles and heels . . . AUTOMATICALLY!

Even the most absent minded worker gets his shoes scrubbed before he enters the area. And, best of all, the dirt drops through the grille, is collected in an easy-to-clean trap, and doesn't accumulate on the threshold. Users claim lower maintenance costs, improved floor wear, cleaner atmosphere . . . and fewer quality rejects. MIRACLE MAT is specified by leading precision manufacturers for "white room" protection.

***Sturdy-Handsome Anodized Aluminum Grille***

***Power-Driven Adjustable Nylon Brushes***

***Instant Step-On Pressure Controls***

***Convenient Dirt Trap***

"the miracle mat"

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| SPERRY GYROSCOPE | GENERAL ELECTRIC |
| WESTERN ELECTRIC | BOEING AIRCRAFT |
| U. S. ATOMIC ENERGY COMMISSION | SYLVANIA |
| R. C. A. | LOCKHEED AVIATION |
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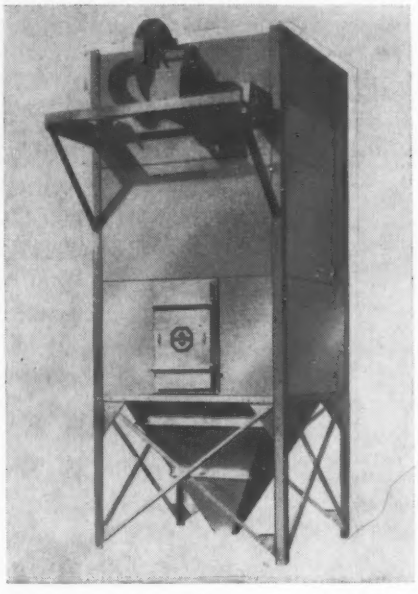
317 HAYDEN ST., N.W., ATLANTA 13, GA.


# *New* PRODUCTS

*(Continued from page 20)*



## Reverse-air Jet Dust Filter

*Purpose:* For use in recovery of industrial process dust.

*Features:* Increased standardization with reduction of number of component parts. Blow-ring assembly features "low-rate" adjusting springs. Uses automatic pressure control for cleaning, without requiring shut-down or by-passing.

*Source:* Koppers Co., Inc., Metal Products Division, Dept. AE-11, Baltimore, Md.

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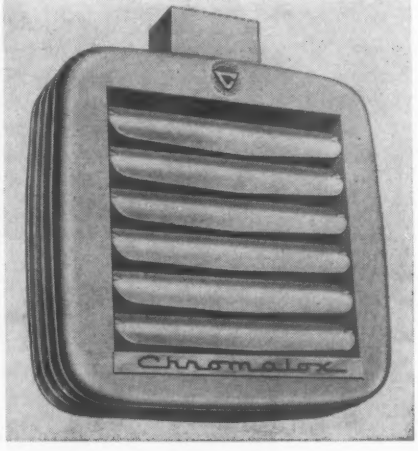


## Electric Unit Heaters

*Purpose:* Manufacturer's new series designed to solve space heating problems in factories, public buildings, stores, garages, warehouses and other similar establishments.

*Features:* Compact in construction, sturdy metal sheath electric elements with built-in line voltage overheat protection. Wide fin spacing permits efficient, economical operation even in dirty atmospheres. Fan motor is totally enclosed, has built-in thermal overload protection.

*Source:* Edwin L. Wiegand Co., Chromalox Division, Dept. AE-11, Pittsburgh, Penn.

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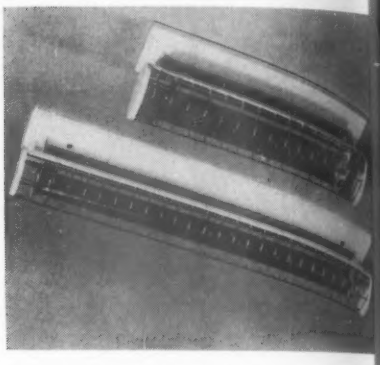


## Zone Control Infra-red Heater

*Purpose:* For infra-red heating concentrated on specific areas.

*Features:* Ten models, three sizes (19½ in., 33 in. and 39 in. fixtures), semi-parabolic shaped reflectors and special end reflectors to assure optimum coverage.

*Source:* Apextro Products Co., Division of Apex Sheet Metal Works, Inc., Dept. AE, 1821 N. Eastlake Ave., Los Angeles 31, Calif.

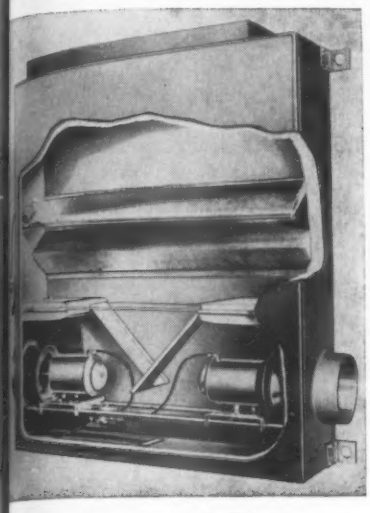
---

## "Tite-Seal" Headgear

*Purpose:* For industrial workers, firemen, policemen — anyone using the same mask all the time where time is important in entering hazardous areas.

*Features:* Contour fitting plastic in the headgear allows easy, comfortable fit on any size or

...ape head. Mask is claimed to be ...-tight. Safety hats and fire ...lmets may be worn without ob...truction from patented headgear. *Source:* Wilson Products Divi..., Dept. AE-11, Reading, Penn.



## ...erminal Control Units

*Purpose:* Control units for all-...r high-velocity systems.

*Features:* Units are available in ...ree ceiling models and two ...indow/perimeter models. Ceiling ...odels come in six sizes and win...w/perimeter models in three sizes. Ceiling units can be had with end discharge, bottom discharge, or multi-discharge.

Claimed by manufacturer to (a) reduce high velocities and pressures for discharge of air at conventional low velocity values; (b) proportion hot and cold flows in response to room thermostat; (c) mix hot and cold flows to provide uniform temperature at discharge; (d) attenuate self-generated noise and duct airborne noise; and (e) automatically control volume of air discharge despite static pressure unbalance (or provide manual control).

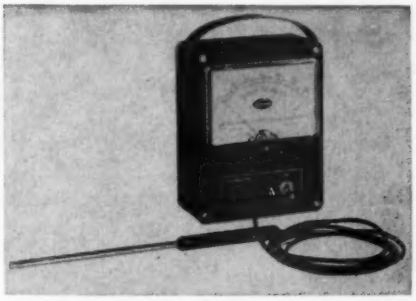
*Source:* Carnes Corp., Dept. AE-11, Verona, Wisc.

## Heat Exchanger "Rotary-X-Changer"

*Purpose:* To recover heat from contaminated exhaust air, or to cool incoming air to air conditioned or refrigerated space.

*Features:* Engineered to fit into the intake and exhaust of a ventilation system. A rotary wheel within the exchanger, filled with heat absorbing material, absorbs heat from contaminated exhaust air and transfers it to incoming fresh air.

*Source:* Heat Recovery Corp., Dept. AE-11, 671 Mt. Prospect Ave., Newark 4, N. J.



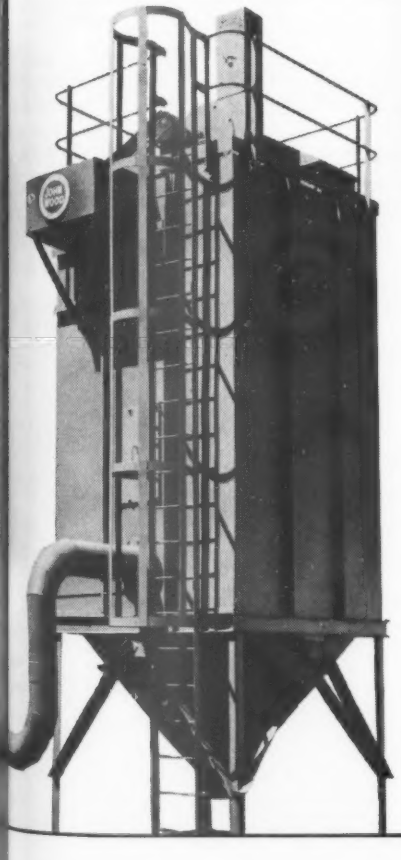
## Temperature Indicator

*Purpose:* For use in steam-generating plants, general industry and consulting engineer use.

*Features:* Unit has thermistor sensing probes and batteries claimed to have an estimated life of several thousand hours. Available in ten different ranges, spanning -30 to 350°F. Uses interchangeable probes in air, liquid and surface temperature sensing. Indicators are priced at $59.50 and probes at $35, f.o.b., Ashland, Mass. Model #583.

*Source:* Fenwal Incorporated, Dept. AE-11, Ashland, Mass.

*(Please turn to following page)*

JOHN WOOD COMPANY
AIR POLLUTION CONTROL DIVISION
ESSEX BUILDING BERNARDSVILLE, N. J.

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HIGH EFFICIENCY DUST COLLECTION
YERZLEY SCRUBBER
GAS CLEANING ABSORPTION
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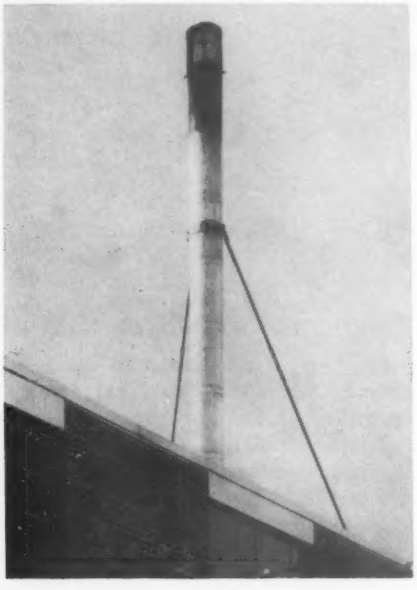
SIMPLE OPERATION, EASY INSTALLATION

*Our experts in product recovery and air pollution control would welcome the opportunity to discuss any of your collection problems with you.*

WRITE FOR EQUIPMENT BULLETINS

# *New* PRODUCTS

*(Continued from preceding page)*



## Refractory Smokestacks

*Purpose:* For use with commercial and industrial incinerators, boilers, and furnaces.

*Features:* Insulated thimble fits around the smokestack sections where they pass through floors and roof and may be installed with zero inches clearance to combustibles. With the insulated thimble in place, actual clearance from the stack section itself to combustible floor and roof materials is reduced from 18 in. to 3 in.

In non-combustible construction the insulated thimble is not required because only a four in. clearance is necessary. In combustible construction only a six-in. clearance is required if flue gas temperatures don't exceed 1000°F.

Flashing and counterflashing offered by manufacturer for the first time. Insulated thimble and accessories available in appropriate sizes for each of the eight inner diameters in which the stack is offered: 10, 12, 15, 18, 21, 24, 30 and 36 in. Underwriters Laboratory approved.

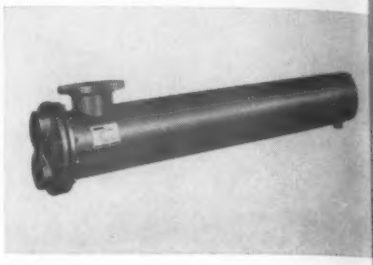
*Source:* Van Packer Co., Dept. AE-11, 1232 McKinley Ave., Chicago Heights, Ill.

## Steam Converter

*Purpose:* For use in heating radiation water with steam.

*Features:* Piping design is simplified and design work is reduced. Said to be highly efficient for providing heating water for office space in industrial buildings. When applied to high buildings, converter keeps static heads at reasonable levels.

*Source:* Dunham-Bush, Dept. AE-11, 179 South St., West Hartford 10, Conn.

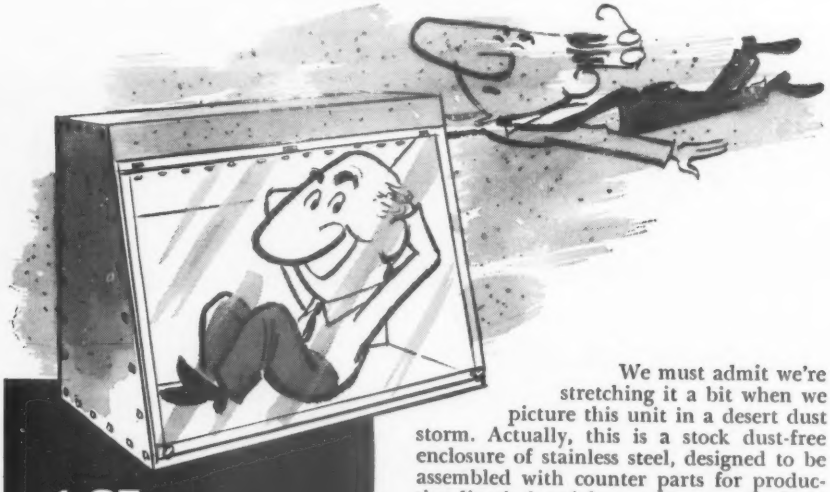


## Material Intake Valves

*Purpose:* Employed in the removal or transport of dry, free flowing, powdery or granular materials from hoppers, bins and dust collectors.

*Features:* Material intake valves are suitable for use on two through six inch pipe lines and come equipped with standard eight inch flanged connections which permit simple and rapid installation on any bin, hopper or collector. Separate air inlet prevents connected equipment from exposure to full suction of the vacuum system. Design of these material intake valves provides for thorough mixing of air and material to insure smooth, non-clogging flow.

*Source:* U.S. Hoffman Machinery Corp., Dept. EM (AE-11), 103 Fourth Ave., New York 3.

1 ST CHOICE FOR DUST FREE PRODUCTION

We must admit we're stretching it a bit when we picture this unit in a desert dust storm. Actually, this is a stock dust-free enclosure of stainless steel, designed to be assembled with counter parts for production line industrial use and can easily function perfectly under such conditions.

We are a division of Kewaunee Manufacturing Co., specializing in engineering and production of highly technical equipment and apparatus for research and industry. Our experience and facilities qualify us to custom design and manufacture, or assemble from stock, any of the following types of enclosures: glove, vacuum and dry boxes; dust free enclosures; and controlled atmosphere systems.

*For complete information, call or write*

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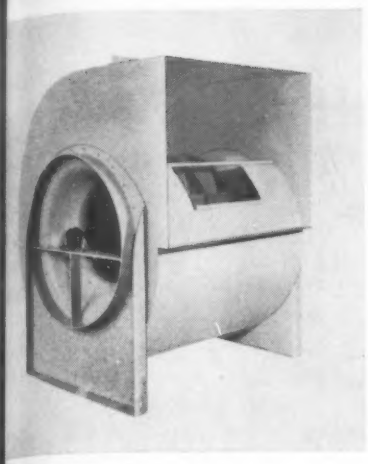


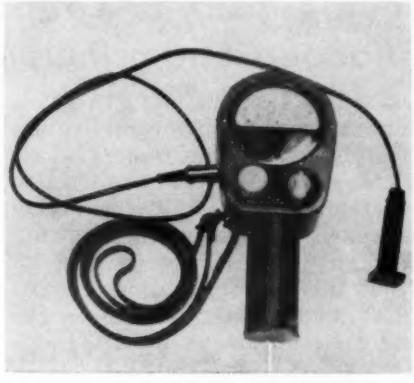
## Backward Curved Blower Fan

*Purpose:* Redesigned blower claimed by manufacturer to meet increasing need for higher pressure, greater volume, higher velocities, and quieter operation in blower fans.

*Features:* Key to redesign is new fan wheel structure which incorporates mechanical changes based on requirements set by consulting engineers to the air conditioning industry and process industries.

Features a deepened inlet cone and all welded, backward curved, spun wheel shrouds. Design for single and double width wheels allows for finer tolerances between stationary and moving parts.

*Source:* Bayley Blower Co., Dept. AE-11, 1817 S. 66th St., Milwaukee 14, Wisc.



## Resistance Thermometer

*Purpose:* For measurement of temperatures of irregular surfaces.

*Features:* Speed of resistance thermometer said to exceed that of standard mercury thermometers by several orders of magnitude (½ time value constant: 2 seconds). Accuracy of one percent of full scale in ranges from 35° to 350°F is available with the instrument. Sensing element of the contact probe is a nickle resistance wire which is said to retain its fine calibration over many years use.

Sensing element is one arm of a bridge circuit. Changes of temperature, which unbalance the circuit, are indicated on the thermometer dial. Power source is standard flashlight battery. Calibrated for direct reading from 30° to 130°F/100° to 350°F, interchangeable by flipping a switch. Cost of probe: $37; of the thermometer, $129.

*Source:* Gelman Instrument Co., Dept. AE-11, 106 N. Main St., Chelsea, Michigan.

## Glass Cloth Dust Collector

*Purpose:* For use as fabric arrester where greater than normal efficiencies are required and high temperatures are a factor.

*Features:* Available in sizes ranging from 1,980 to 17,825 cfm in single units. Siliconized custom-made glass fabric bags are designed to withstand constant temperatures of 550°F. Bags available in 11½ in. diameter and from 14 to 21 ft. in length. Collapses pneumatically to dislodge collected dust.

*Source:* American Air Filter Co., Inc., Dept. AE-11, Louisville 8, Kentucky.


EXECUTIVE REPORT #6

# FILTER FABRICS THAT DEFY THE ELEMENTS

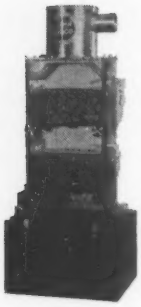
No problem is too tough for Wheelabrator® Dustube® Collectors

High temperatures, corrosive or abrasive contaminants in the collected gases pose no insurmountable problems for Wheelabrator Dustube Collectors. These efficient cloth bag type collectors are made exceptionally versatile by use of synthetic filtering fabrics of treated glass, Nylon, Orlon, Dacron, etc., which afford long service life and optimum resistance to acids, alkalis or abrasive materials encountered in any specific application. For example, with Wheelabrator Glastube® collectors employing glass filter fabric tubes, temperatures up to 550° F. can be accommodated.

***Dustube Collectors offer high efficiency and low cost for equipment and operation***

Collection efficiencies uniformly above 99% by weight and 95% by dispersion test are regularly achieved by Dustube systems in a wide range of applications. For engineering information write to Wheelabrator Corp., 498 S. Byrkit St., Mishawaka, Ind. In Canada, P. O. Box 490, Scarborough, Ontario.

WHEELABRATOR
DUST AND FUME CONTROL



# *New* PRODUCT OF THE MONTH

## Recently, an advance in gas-liquid scrubbers was made. Here is a report on the units and their flooded-bed principle, with applications.

A NEW CONCEPT in a gas-liquid scrubber, said to be an advance over more conventional types, in that it can be used under flooded conditions, has been introduced to the new products market.

The scrubber is furnished with two horizontal beds of 5/8 inch size crushed rock resting on a screen support. The beds are six inches deep, located one above the other, with a two foot space between them. The vessel shell is constructed of sheet steel, lined with polyvinyl chloride.

A fan located on the gas outlet is built integral to the scrubber. Windows on the sides of the vessel permit observation of the scrubbing action in the beds, and manometers are furnished to indicate the pressure differential across each bed. Scrubbing liquid enters through spray nozzles located above each bed, and runs down through the unit to a drain.

### Principle Of Operation

In this new-concept scrubber, the scrubbing liquid is supported by a rising column of gas which maintains a flooded condition. Due to a flooded bed resistance, the air is broken into tiny bubbles, about 1/8 inch in diameter, which are completely surrounded by the scrubbing liquid. This intimate interphase relationship, plus the impaction forces due to the continuous change of direction and bubble break-up, is reported to account for rapid absorption.

### Product In Operation

A recent test conducted by a large electric equipment manufacturing company, whose industrial problem was to find a suitable device to absorb hydrochloric acid vapors in concentrations up to 10,000 ppm, showed that the major part of the acid could be absorbed in the first two inches of the lower scrubber bed with an efficiency of virtually 100 percent.

The unit operated at 1000 cfm of air with water supplied at six gpm and a total pressure drop of nine inches. An important feature of this installation were the remote controls which are located strategically close to the operating personnel responsible for the unit. The unit was turned on and off from this remote station and its performance determined by viewing the manometers located there.

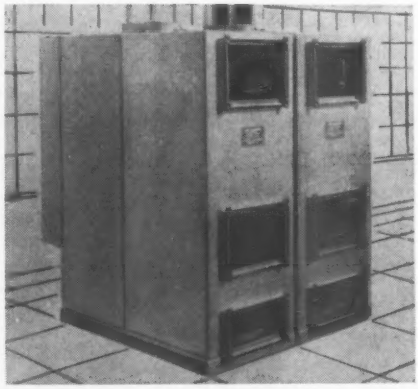
### Handles Obnoxious Fumes

Another installation was made at a long established plant in a suburban community. Here the problem was obnoxious fumes of a complex nature, including vapors from vegetable oils, $H_2S$, and volatile amines. Community legislation ordered the plant to clean up or shut down.

Research indicated that by introducing chemical additives and circulating them through one of the scrubber beds, the oil accumulation could be effectively washed out and offending odors absorbed.

At one leading lamp manufacturing plant, the scrubber was used to treat fumes from a total of six hoods: two in which molybdenum mandrels were dissolved in a mixture of nitric and sulfuric acids and four in which steel mandrels were dissolved in hydrochloric acid.

Here, the scrubber installation consisted of a total of five units: two primary units, 200 cfm each, which drew off concentrated fumes of oxides of nitrogen from the molybdenum dissolving hoods and returned the clean vent air to the same hoods, and three secondary units of 2000 cfm each, which treated the combined gases from the six dissolving hoods.



*Twin units, each rated at 200 cfm, for direct absorption of concentrated surges of $NO_2$ in water.*

Tests on this cyclical operation showed that the primary units were operating at efficiencies of 90 percent on peak concentrations up to 60,000 ppm. Secondary units indicated efficiencies of 70 percent.

It is reported that overall removal efficiencies in the order of 90 to 95 percent for this application could have been achieved by use of two scrubber systems in a series with suitable air dilution and time delay to allow for re-oxidation of nitrogen oxide to nitrogen dioxide.

Further, it was found that the scrubber was effective in reducing oxide of nitrogen fumes to a level at which they are invisible, except at short peak periods of the emission cycle when a light coloration may be observed.

The entire system handles these acid fumes with water as the sole scrubbing medium.

As a final example, in a small city, $SO_2$ fumes, escaping from a hot vat heated with live steam, were the cause of serious pollution complaints. Because of a liquid disposal problem, it was not desirous to collect condensate. As a result, steam escaping from the bath acted as a carrier for the $SO_2$ fumes.

Operation of a 100 cfm pilot scrubber unit at 200°F, using a solution of sodium carbonate, recirculated at one gpm from a sump, resulted in absorption of the $SO_2$ and discharge of clean steam with a minimum of condensation.

The scrubber and principle of operation are the invention of Felix L. Yerzley. Called the *Yerzley Scrubber,* the unit comes in three types: Twin 200 cfm, 1000 cfm rooftop unit, and a 2000 cfm unit. The scrubbers are being manufactured by the John Wood Co., Bernardsville, N. J. ▲▲

## New Products . . .

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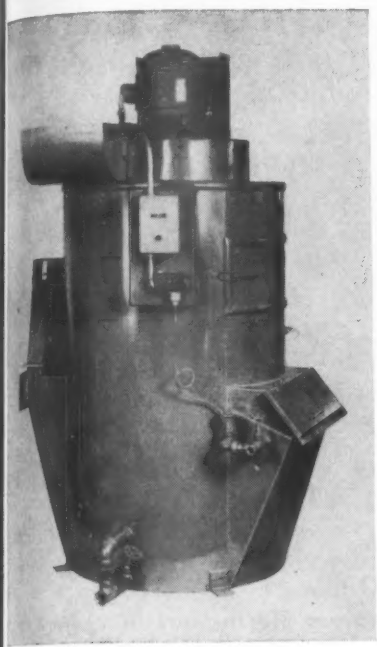

### Wet Type Dust Collector

*Purpose:* To remove dirt, dust, grindings, chips, fumes and vapors from air streams.

*Features:* Standard elements can adapt to most installations. Compact, adaptable to metal grinding and finishing operations. No pumps or agitators are used in air-washing process said to employ new principle for washing, scrubbing and fogging contaminants out of air stream and depositing them as wet sludge for manual or automatic removal.

*Source:* DeVilbiss Co., Dept. AE-11, Toledo, Ohio.

### Mixing Boxes and Attenuation Chambers

*Purpose:* For hot and cold air proportioning in response to room thermostat.

*Features:* Simple design eliminates linkages and pivots. Only one motor employed to operate mixing valves. Unique volume regulator said to guarantee constant control of air delivery at required volume. Attenuation chambers are designed to assure low sound ratings.

*Source:* Air Devices Inc., Dept. AE-11, 185 Madison Ave., New York, N.Y.

*Use Communications Center, page 35, for requesting more information about articles, advertised products, literature, etc.*


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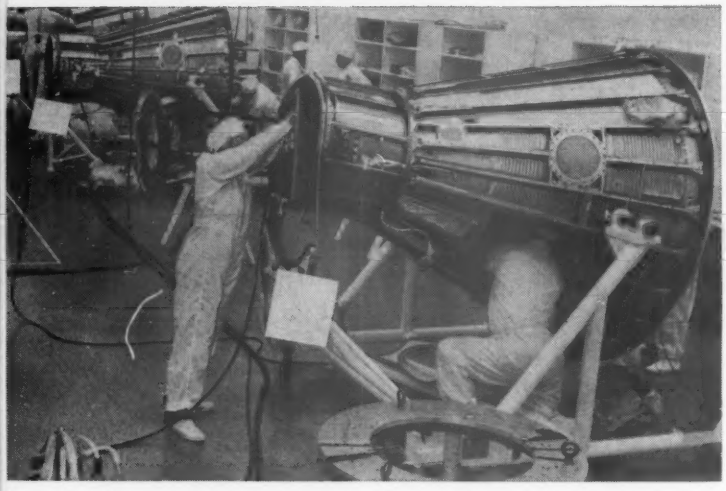

Fig. 1: *Portion of assembly line in class six white room at McDonnell Aircraft Corp. plant. Workers are assembling "Project Mercury" space capsules, in which first American astronauts will go into orbital flight.*

# White Rooms for Project Mercury

**by G. R. Kline**
***Plant Engineer, McDonnell Aircraft Corp.***

A speck of dust in complex gear of manned space capsule in project Mercury could tumble astronaut out of orbit. Here's how McDonnell Aircraft Corp. builds space capsules under super-clean conditions. Article gives white room design, construction, make-up air and zone control, maintenance details.

A SIGNIFICANT ROLE in the space age was undertaken by McDonnell Aircraft when the National Aeronautics and Space Administration selected McDonnell to design, develop, and construct the first U.S. manned Space Capsules.

The capsule is designed to carry a human astronaut beyond the atmosphere into orbital flight around the earth and bring him safely back to earth. The program, called "Project Mercury," will provide a means of recording and studying the psychological and physiological effects of space flight on man.

The capsule, designed to withstand any anticipated combination of acceleration, heat input, and aerodynamic force, will provide a controlled environment to protect the astronaut against the hostile conditions of outer space, and will provide him with the option of manual or automatic controls. Optical displays will show portions of the earth and sky to help him to position the capsule in the desired orbital or re-entry attitude.

In this program, there is no margin for error. All controls, both reaction and environmental, must function perfectly and respond accurately and immediately. These highly complex electronic controls can tolerate neither dust particles to interfere with operating mechanisms, nor rust which might originate from human contact during assembly operations, and which might cause equipment failure. Under high G loadings, the smallest rivet or drill bit, if dropped and not recovered, could become a dangerous projectile and cause failure of a system. To insure freedom from contamination of the capsules and their complex equipment, it is necessary that the assembly operations be performed in an area having a high degree of environmental perfection – an area known as a "Super Clean White Room".

To gain access to the Super Clean White Room (Fig. 3), personnel must first enter a locker room (Zone 1) where their shoe soles are brushed (Fig. 7) and vacuumed automatically, and where they must change into dust free, company supplied clothing. All tools, parts, and assemblies must be cleaned prior to white room entry. No smoking or eating is permitted; pasteboard boxes or paper containers are not permitted; and unnecessary materials of any kind are prohibited to reduce internal generation of dust. Cleaning operations during production are restricted to damp mopping, and to vacuuming with a cleaner with its collection system outside the area.

Such rigid control of environmental conditions imposed the following design considerations:

1. Rooms must be air conditioned to maintain a temperature of 74°F and a relative humidity of not over 50 percent for worker comfort, control of perspiration, and dimensional control of materials.

*Fig. 2: Class six white room, showing a portion of a special electronic assembly area with solder pot exhausters. Note light pattern and ceiling diffusers.*

2. Incoming air must be filtered as completely as possible.

3. Rooms must be completely enclosed and pressurized at all times.

4. Floor must be covered with non-dust-generating material. (Vinyl tile was selected.)

5. Walls and ceilings must be painted with white gloss enamel to retard accumulation of dust and facilitate cleaning.

6. Area must be free of ledges, overhangs, or protrusions to minimize dirt traps and simplify cleaning.

7. A minimum of 150 foot candles must be maintained at the working surfaces of benches.

8. Entrances to the area must be of the air lock type to minimize pressure loss.

9. Windows must be provided in each room (except locker room) with intercom systems and pass through locks to minimize entry.

10. A locker room must be provided for storage of clothing, for dressing, and for personnel entrance into the white rooms.

11. A central type vacuum cleaning system must be provided, with the vacuum producer and discharge outside the area. (See Fig. 6).

12. An automatic shoe cleaner must be provided at the entrance to clean the bottom of employee's shoes as they enter the area.

13. Compressed air for production requirements must be filtered to the same standards as room air.

14. The construction site must be on the production floor of the main factory assembly area.

These specifications, which collectively constitute a Super Clean White Room, had to be met quickly and adequately when the top priority "Project Mercury" mushroomed from the design stage to the production stage immediately following selection of McDonnell to develop the capsule.

Normal procedures, which can be followed when time permits, had to be discarded in the interest of expediency. Design and construction in this case had to start before layouts were prepared. As layouts changed to meet new demands, equipment heat gain calculations and the amount of air required to pressurize the rooms also had to be changed. To avoid changing basic air conditioning equipment several times, a safe figure was calculated for the ultimate anticipated maximum loads, and design proceeded on this basis.

While design and construction of the Mercury white room was being pushed, production requirements of Electronic assembly were found to require a white room, which was equal in size and could be

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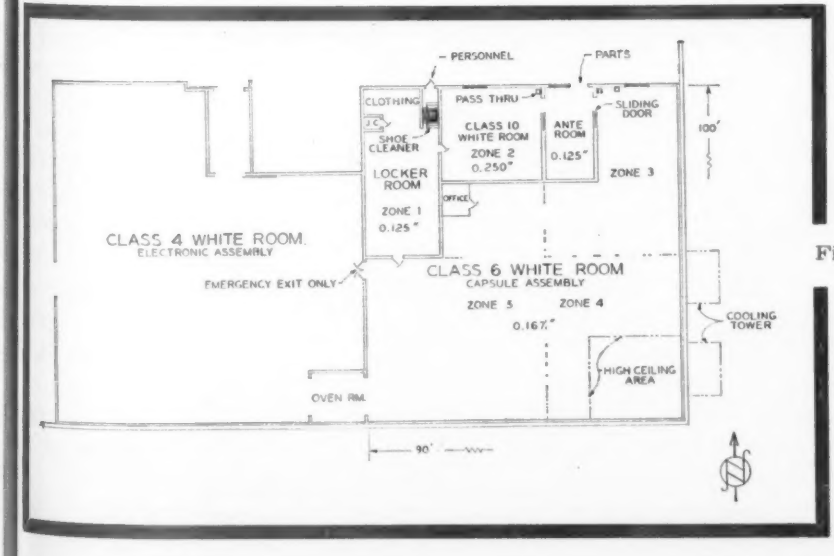



Fig. 3: *Layout of white room assembly area.*

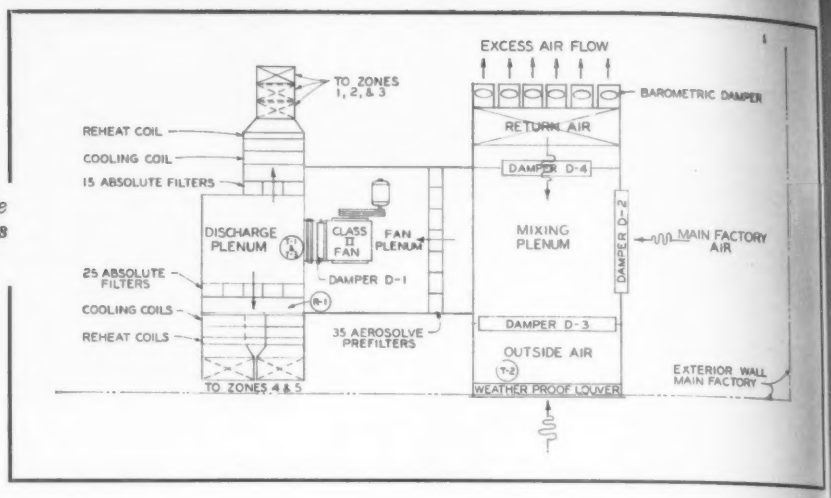



**Fig. 4:** ***Plan view showing layout of white room air handling system, located in truss of main factory building.***

*(Continued from preceding page)*

located adjacent to the white room under construction. Since the area was similar to the Mercury area in heat gain, it was found desirable to combine the chilled water circuits, condenser water circuits, and the central vacuum system (Fig. 4). This enabled us to double the number of units and to obtain the air conditioning advantages of a greater capacity reduction on light load days, lower installation costs per ton, centralized maintenance, and additional flexibility in maintaining continuous conditioning in event of a partial equipment failure.

Paralleling of four chillers, for example, enables us to maintain desired room conditions in event of one chiller failure. This is extremely important, as failure to maintain acceptable environmental conditions could result in a complete shutdown.

The Mercury White Room is literally a building within a building, being erected on the main factory floor to meet production requirements. Since the lower chord of the main factory truss is 20 ft above the main floor, the white room ceiling was established at 12 ft, and the wood joist framed ceiling was suspended from the main building truss by rods, and further supported on load bearing partitions to enable the room to be devoid of supporting columns, and to reduce air conditioning requirements. One area, 30 ft x 35 ft, has a ceiling height of 17 ft 6 in. because of special assembly requiring more than a 12 ft ceiling.

The already existing floor of the room is a 19 in. thick reinforced concrete slab with basement below. Walls are 2 x 4 studding with ⅜ in. gypsum board on the interior, and 1⅛ in. Cemesto board on the exterior. The ceiling is constructed of 2 x 8 joists tied into the 6 in. x 12 in. wood beams, covered on the interior with ⅜ in. gypsum board, insulated with 2 in. fiberglas batts and covered with aluminum decking.

Lighting consists of ceiling surface mounted continuous rows of fluorescent fixtures with completely enclosed prismatic lenses providing for 150 foot candles maintained at bench level. Also provided are electrical services for 120V 60 cycle single phase, 208V 60 cycle 3 phase, 440V 60 cycle 3 phase, and 28 volts DC.

The white room area is divided into assembly rooms, in accordance with the cleanliness priority required for the particular assembly operations (Fig. 3), and is dependent upon the type and amount of operations, amount of traffic, and internally generated dust. The assembly of the environmental and reaction controls is performed in an area separate and isolated from the main assembly area (Fig. 3). It was agreed that the large assembly room could require a lesser degree of filtration, but not less than

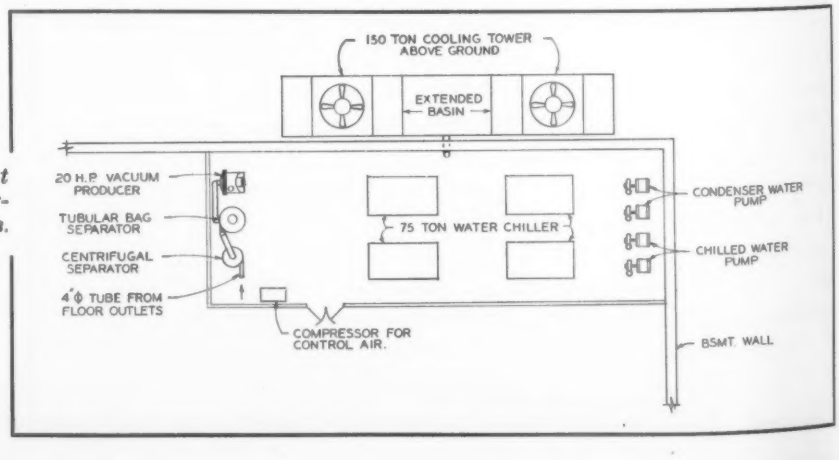



**Fig. 5:** ***Layout of basement equipment room and cooling towers for Project Mercury and electronic assembly white rooms.***

Fig. 6: *One of many vacuum attachments in floor of class six white room.*

an average filtration of 85 percent, according to the National Bureau of Standards Discoloration Method. However, in anticipation of possible future needs, it was decided to use super-interception filters.

The conditioned air entering the space is first pre-filtered ahead of the conditioned air fan by a battery of 35 disposable element filters with an estimated life of six months, with air conditioning 24 hours per day, 7 days per week. Initial resistance is 0.16 in. w.g., and final resistance, when change is due, 0.7 in. w.g. Average efficiency is 96 percent removal of all air-borne particles. The final filtering after the fan is done by two banks of super-interception filters, 99.97 percent effective against 0.3 micron particles.

One bank of 15 filters serves zones 1, 2, and 3; and one group of 25 filters serves zones 4 and 5 (Fig. 3). Initial resistance is 0.7 in. w.g., and final resistance 2.0 in., w.g., when change is due. Life is estimated at 14,250 hours of service (1 year, 7½ months). A total fan static pressure of 4½ in. with all filters dirty and needing replacement, has been provided for.

Each room is pressurized to prevent infiltration of dust, according to its cleanliness priority which is based on a relative scale of 1 to 10, with class 10 having the most stringent requirements. The class 10 white room has the highest pressure of 0.250 in., and relieves with doors shut, through barometric dampers, into the class 6 white room at 0.167 in. (Fig. 3). The anteroom and the locker room are maintained at 0.125 in. and relieve to the general shop (at zero reference pressure) through a relief air duct connected to the automatic shoe cleaner.

The class 6 white room relieves to the main factory area (Fig. 3) through barometric dampers above the oven area (outside the white rooms) and in the return air duct (Fig. 4). The return air grille is 14 ft above the floor and is located in the high ceiling area directly below the air handling platform in the trusses.

Fresh air requirements were computed on the following basis:

1. The opening of the entry doors into the locker room and anteroom would cause a loss of the 2700 cfm supplied directly to these rooms. In addition, with the higher pressurization of the class 6 and 10 rooms and their entry doors open to the locker room, the outflow potential rises to 7000 cfm.
2. 6000 cfm of objectionable fumes must be continually exhausted.
3. 2000 cfm must be allowed for barometric damper loss around the edge of the dampers.
4. In mild weather, economizer controls will position to bring in 100 percent outside air, (fan cfm = 32,000).

Barometric dampers were sized for relieving all 32,000 cfm. The proportioning dampers in the return air duct were sized for a maximum of 17,000 cfm with a 0.25 in. pressure drop.

The field erected multi zone air handling unit, located on the overhead equipment platform, air conditions all sections of the white room area, with five separate zones individually controlled (Fig. 1). Each zone has a thermostat and humidistat combined under a common cover.

*The pneumatic control system operates as follows:*

When temperature or humidity rises above the zone thermostat or humidistat setting, a three-way valve modulates chilled water flow to the cooling coil to maintain desired temperature and humidity. The thermostat also modulates a steam reheat valve to maintain desired room temperature after de-

*(Please turn to following page)*

Fig. 7: *Automatic air shoe cleaner at entrance to locker room.*

*(Continued from preceding page)*

humidification has been accomplished.

When the supply fan is not running, all controls assume their normal postions. As the fan starts, an air valve is energized to allow the following sequence (Fig. 4):

Thermostat T-1 (in discharge plenum) modulates damper D-2 (main factory air), D-3 (outside air), and D-4 (return air) to maintain the desired fan discharge temperature of 55°. When outside temperature rises above 65°, thermostat T-2, (outside air) overrides T-1 to return dampers to their minimum positions. As fan discharge temperature drops to 50°, thermostat T-3 (in discharge plenum) acts as a low limit to return dampers D-3 and D-4 to their normal positions, and opens D-2 to limit the outside air-shop air mixture to 50°. Static pressure regulator R-1 modulates damper D-1 to maintain constant air flow, the control line being restricted for slow action. The prime function of the Johnson Service Co. R-302 static pressure regulator is to remove resistance to flow at D-1 to offset increasing filter resistance as the filters become dirty. The damper is designed to react slowly so it will not react to pressure changes caused by normal opening and closing of doors, and assures constant flow to all zones after the original balancing of zone dampers.

*The control sequence for chiller operations is as follows:*

A a rise in outdoor temperature to 54°, an outdoor thermostat controls three P.E. switches to: (1) start the condenser water pump, (2) start the chilled water pump, and (3) energize a solenoid air valve to activate an eight point pneumatic step con-

*(Please turn to page 58)*

## CREDITS

| | |
|---|---|
| Architect: | *Plant Engineering Department of McDonnell Aircraft Corporation* |
| Engineers: | |
| General Contractor: | |
| Field Supervision: | |
| Room Construction: | *Schmelig Construction Co., Inc.* |
| Piping: | *Natkin and Co.* |
| Sheet Metal: | *T-W Heating and Sheet Metal Co.* |
| Controls: | *Johnson Service Co.* |
| Electrical: | *Osborn Electric Co.* |

## EQUIPMENT INSTALLED

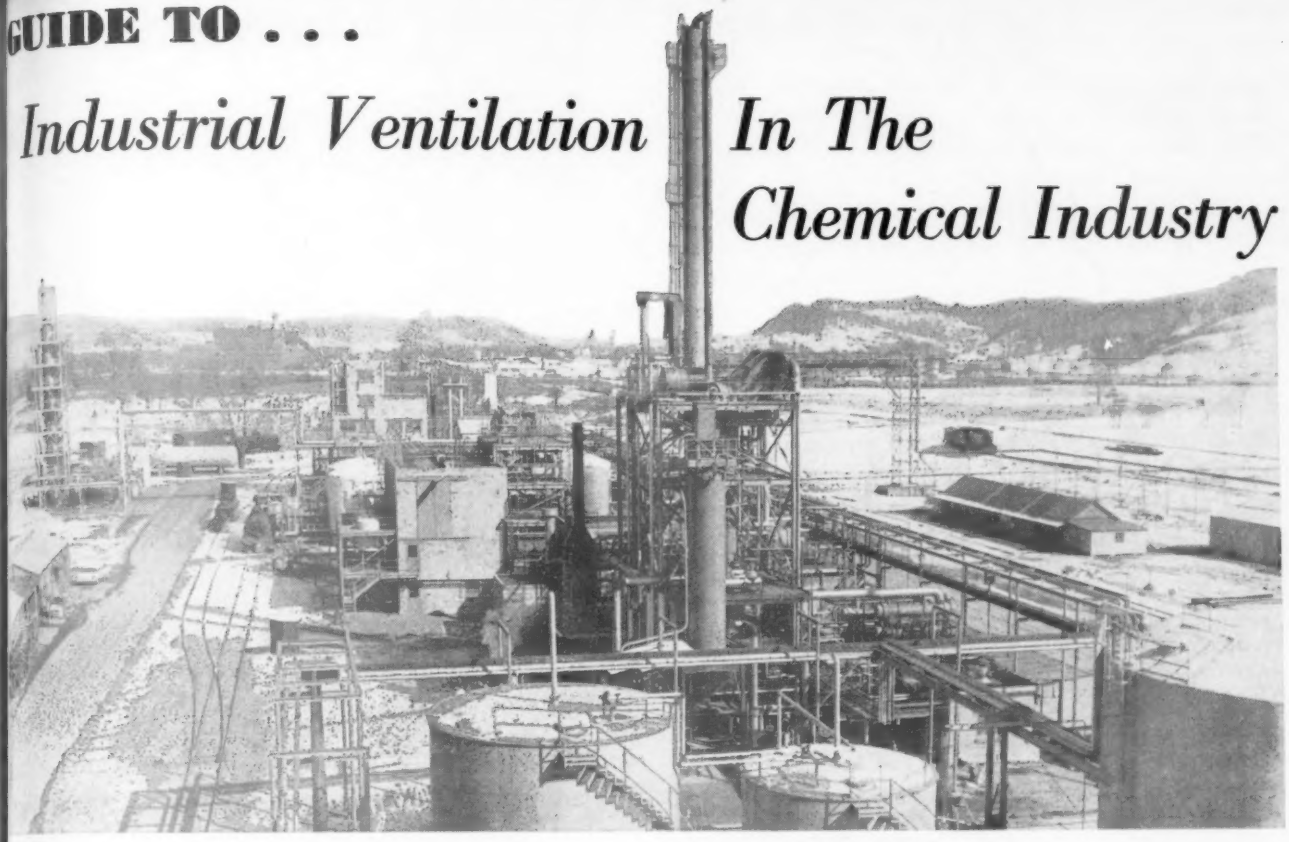
| | |
|---|---|
| Liquid Chillers: | *The Trane Co.* |
| Coils: | *Marlo Coil Co.* |
| Cooling Towers: | *The Marley Co.* |
| Pumps: | *Bell and Gossett* |
| Supply Fan: Aerosolve No. 35 | *Westinghouse Electric Corp., Sturtevant Div.* |
| Filters; Pre-fiilters and super-interception filters: | *Cambridge Filter Corp.* |
| Air Diffusers: | *Air Devices, Inc.* |
| Controls: | *Johnson Service Co.* |
| Vacuum Producer: | *Spencer Turbine Co.* |
| Shoe Cleaner: | *The Progressive Engineering Co.* |

## REGULATIONS FOR PERSONNEL ENTERING CLASS 6 AND/OR CLASS 10 WHITE ROOMS

1. Tool boxes shall not be allowed within white room.
2. Hand tools shall be cleaned prior to entry; carried in and stored in wire baskets.
3. Parts and assemblies shall be cleaned prior to white room entry.
4. Pasteboard boxes or paper containers are not permitted within white room.
5. Full white uniforms are mandatory at all times for all personnel in white room. This includes cap, coveralls and shoes for full time employees including socks for those entering capsule; cap, shop coat and plastic footlets for visitors.
6. Full uniform shall be removed and street shoes worn when leaving white room.
7. Clothing shall be changed at least once every two days or more as required.
8. Uniforms shall be properly fastened at all times within the white room. Caps shall be worn in such a manner that they cover the largest portion of wearer's hair.
9. Visitors not permitted to enter white room except with supervisory authorization.
10. Locker tops shall be kept clean and clear of clothing or other materials.
11. Lockers shall be kept neat and clean inside. Periodic checks will be made.
12. Hands shall be clean while performing all work.
13. Unnecessary material of any type shall be prohibited in the white room.
14. Smoking or eating shall not be permitted in locker room or white room at any time.
15. Damp mopping may be accomplished during working hours — floor polishing shall be allowed only during non-working shifts.
16. Assemblies shall be covered during non-working shifts with plastic sheet.

**GUIDE TO . . .**

# *Industrial Ventilation In The Chemical Industry*



*View of American Cyanamid Co.'s new aniline manufacturing facilities at Willow Island, W. Va. Plants such as these require careful design of ventilating systems to maintain employee health.*

**By William V. Andresen**
***Chief Industrial Hygienist***
***American Cyanamid Co.***

**Methods of ventilation of pressure filters used in the chemical industry are here discussed, together with attendant problems of design, control, and exposure.**

GENERAL CONSIDERATIONS in chemical filtration and the design of ventilation for vacuum filters, batch and continuous, were discussed in the previous article, (Oct. issue).

There are three general types of closed pressure filters used in chemical processing: (1) Nutsche Pressure Filter; (2) Leaf Type Filter, and (3) Cartridge Filter.

Solvents, acids, alkalis and other toxic or irritating liquids may be utilized in closed pressure filtrations as the liquid to be filtered or as the washing liquor. Since the filter is closed during filtration and washing cycles, no employee exposure occurs during these operations. Exposure may occur during removal of the filtered product or during filter cleaning and setting-up operations.

In some filtrations, it is possible to backwash the filter with water and remove all toxic or irritating material before opening the filter casing. In such an operation, ventilation for the control of toxic or irritating gases, mists and vapors is not required.

One type of pressure filter used in chemical filtration is the Nutsche filter It is generally used to deliquify and wash a final solid product. This filter is similar in design to the Nutsche vacuum filter described in a previous article. However, the filter medium is enclosed in a pressure-tight casing and filtration is accomplished by pumping a solid-liquid mixture into the casing under pressure, which forces the liquid through the filter into a collecting chamber. Washing of the filter cake is accomplished by pumping the wash liquid into the casing under pressure. Air pressure is used to deliquify the filter cake prior to cake removal.

Fig. 1 shows a hood design for one type of Nutsche pressure filter for control purposes during cake removal. The filter casing is provided with a door in the side for removal of the filter cake. This booth type hood enclosure is provided with flexi-

*(Please turn to following page)*

***WILLIAM ANDRESEN** is chief industrial hygienist for the American Cyanamid Co. A graduate engineer, he is vice chairman of the Bergen County, New Jersey air pollution control committee. He is also a delegate from the National Safety Council to the American Standards Association committee Z-9 on industrial ventilation. He is a member of the American Industrial Hygiene Association.*

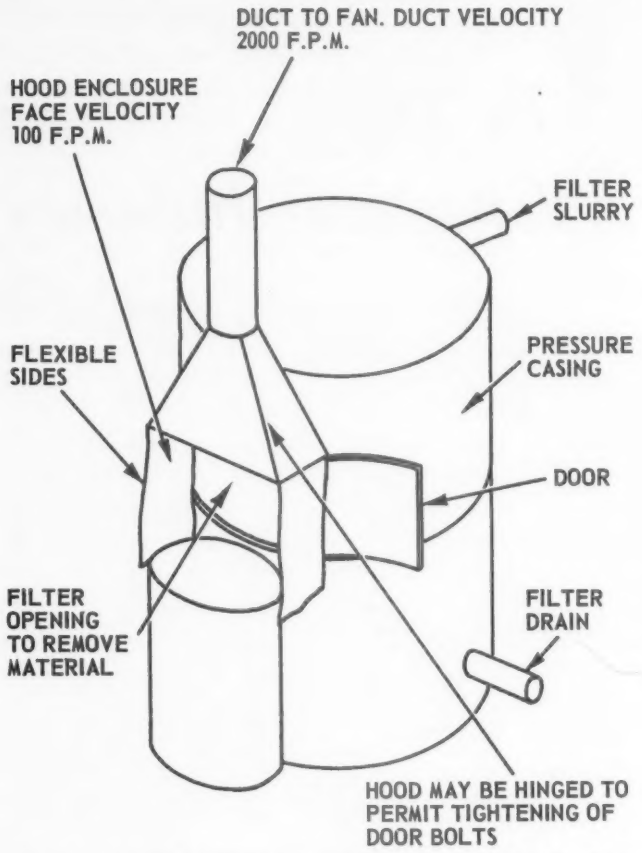

DUCT TO FAN. DUCT VELOCITY 2000 F.P.M.
HOOD ENCLOSURE FACE VELOCITY 100 F.P.M.
FILTER SLURRY
PRESSURE CASING
FLEXIBLE SIDES
DOOR
FILTER OPENING TO REMOVE MATERIAL
FILTER DRAIN
HOOD MAY BE HINGED TO PERMIT TIGHTENING OF DOOR BOLTS

**Fig. 1:** *A booth type hood enclosure provided with flexible sides to allow easy opening and closing of filter door. Designed for a Nutsche pressure filter.*

*(Continued from preceding page)*

ble sides to allow easy opening and closing of the filter door. A velocity of 100 fpm across the hood face will usually provide the desired control.

Satisfactory control may also be realized by using a portable hood which may be attached to the filter door when it is opened. A hood design similar to the one shown in Fig. 1 may be used.

## Leaf Type Filter

The leaf type pressure filter is widely used both for filtration of a final solid product and for clarification of a liquid product. The leaf type enclosed pressure filter is available in various sizes. Both horizontal and vertical filters are available commercially. In either design, the material to be filtered is introduced under pressure into the casing containing the filter leaves. Liquid filters through the porous face of the leaves to the inside of the leaves and is discharged through a pipe outside of the filter.

Usually no problem occurs during filtration and washing. If the filter cake can be washed free of contaminant or sluiced off the filter leaves as in self-sluicing designs, no exposure problem will be encountered in filter cleaning either. In many filtrations, it is impossible or undesirable to wash the filter before opening and cleaning hood enclosure and mechanical ventilation may be required to control toxic or irritating gases, mists and vapors. Fig. 2

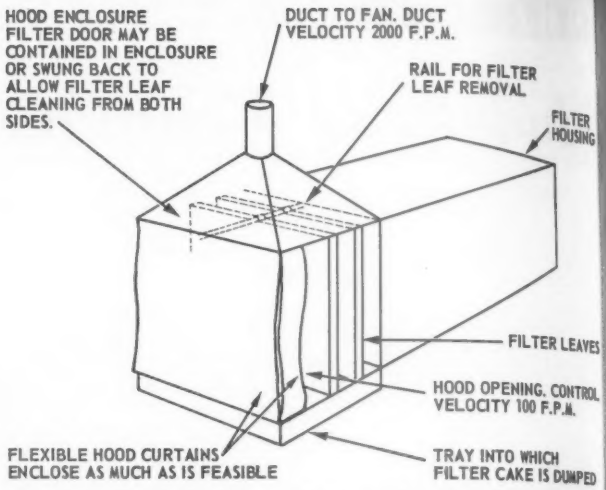

HOOD ENCLOSURE FILTER DOOR MAY BE CONTAINED IN ENCLOSURE OR SWUNG BACK TO ALLOW FILTER LEAF CLEANING FROM BOTH SIDES.
DUCT TO FAN. DUCT VELOCITY 2000 F.P.M.
RAIL FOR FILTER LEAF REMOVAL
FILTER HOUSING
FILTER LEAVES
HOOD OPENING. CONTROL VELOCITY 100 F.P.M.
FLEXIBLE HOOD CURTAINS ENCLOSE AS MUCH AS IS FEASIBLE
TRAY INTO WHICH FILTER CAKE IS DUMPED

**Fig. 2:** *Hood design used in conjunction with a horizontal enclosed leaf filter. Sides are flexible, but permanent sides can be utilized.*

shows a hood design which has been used successfully in conjunction with a horizontal enclosed leaf filter.

The hood sides (Fig. 2) are made of flexible material to facilitate opening and closing of the press but permanent sides can also be utilized. A control velocity of 100 fpm across the hood face opening will usually provide satisfactory control. A tray may be provided to collect the filter cake removed during press cleaning. The door of the pressure filter may either be contained within the hood dur-

*(Please turn to page 37)*

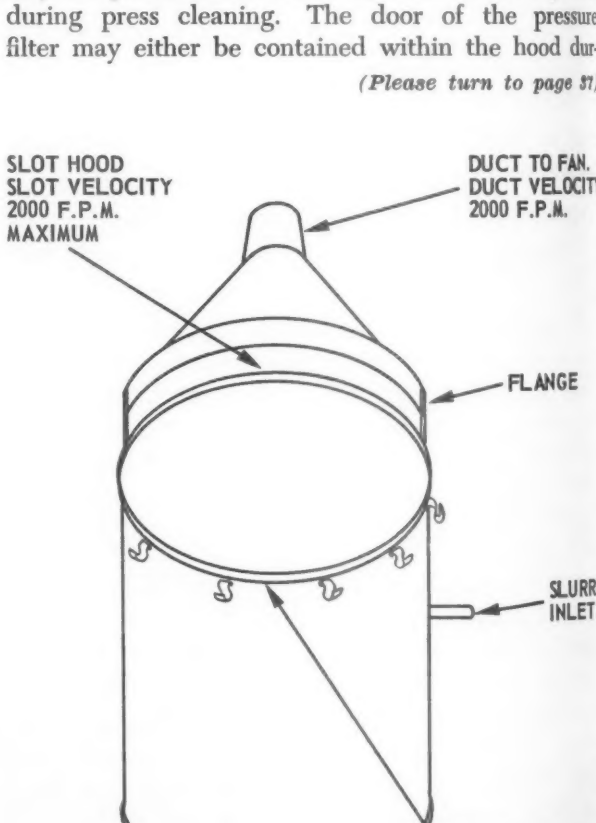

SLOT HOOD SLOT VELOCITY 2000 F.P.M. MAXIMUM
DUCT TO FAN. DUCT VELOCITY 2000 F.P.M.
FLANGE
SLURRY INLET
PRESSURE FILTER TOP REMOVED

**Fig. 3:** *When cleaning filter leaves from a relatively large vertical closed filter, a hood enclosure similar to this may be used for control of toxic gas and vapors.*

# Chemical Ventilation . . .

*(Continued from page 34)*

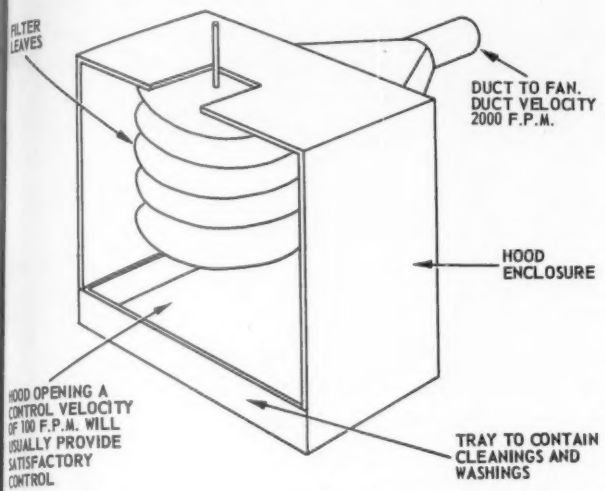

FILTER LEAVES
DUCT TO FAN. DUCT VELOCITY 2000 F.P.M.
HOOD ENCLOSURE
HOOD OPENING A CONTROL VELOCITY OF 100 F.P.M. WILL USUALLY PROVIDE SATISFACTORY CONTROL
TRAY TO CONTAIN CLEANINGS AND WASHINGS

Fig. 4: *Should it become necessary to clean filter housing between batches, a slot hood such as this will usually provide control desired.*

ing cleaning operations or swung back outside of the hood to allow filter leaf cleaning from both sides of the hood if it is necessary.

Cleaning of the filter leaves of a vertical type closed filter is usually accomplished by removing an assembly which contains the leaves from the filter and cleaning the leaves in a separate area. If the filter cake contains residual toxic or irritating vapors, or if it is necessary to use solvents as the cleaning agent, it may be necessary to perform the cleaning operations within a hood enclosure. Fig. 3 shows the design of a hood enclosure which may be used to control toxic gas and vapors when cleaning filter leaves from a relatively large vertical closed filter. The leaf assembly is lifted from the filter by a chain hoist and placed within the hood. A 100 cfm hood face velocity usually provides satisfactory control.

The opening of the filter and removal of the filter leaf assembly usually takes only a few minutes. The filter can then be closed and no control is required. If, however, it is necessary to clean the filter housing between batches, it may be necessary to provide ventilation.

A slot hood design as is shown in Fig. 4 will usually provide the control desired. Small vertical or horizontal leaf pressure filters may be enclosed within a ventilated booth so that all operations where exposure may occur can be performed within the booth. Fig. 5 shows the general design of such an enclosure for a vertical pressure filter. A similar design may be used for horizontal filters.

Satisfactory control can usually be realized by a face velocity of 100 fpm across the maximum hood opening required for press operations. Containers into which the press cake is discharged may be located within the booth enclosure and will not require additional control ventilation. The control air volume requirements can be lessened by the use of sliding panels or curtains at the face of the hood.

## Cartridge Type Filter

The cartridge type pressure filter consists of a "throw-away" filter cartridge which is contained within a pressure-tight casing. The cartridge filter is usually relatively small and is used to clarify or polish liquid products.

There is no employee exposure during filtration because the filter is closed. The removal of the filter cartridge for replacement with a new cartridge is the only operation in which the operator can be exposed to toxic or irritating gases, mists and vapors. Although cartridge replacement takes only a short period of time, it may be necessary to utilize mechanical exhaust ventilation and hood enclosure to provide control of these toxic or irritating gases.

Fig. 6 shows a method of effective control by enclosure of the entire cartridge filter within a ventilated hood. All operations including storage of the

*(Please turn to page 57)*

Fig. 5: *Vertical or horizontal leaf pressure filters may be enclosed within a ventilated booth, thus allowing operations to be performed within the booth.*

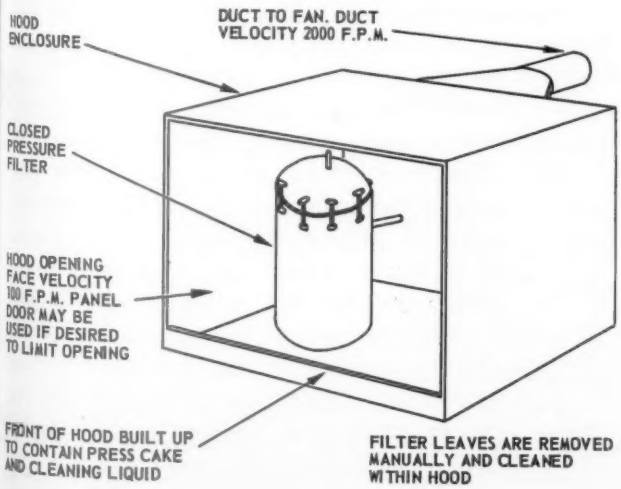

HOOD ENCLOSURE
DUCT TO FAN. DUCT VELOCITY 2000 F.P.M.
CLOSED PRESSURE FILTER
HOOD OPENING FACE VELOCITY 100 F.P.M. PANEL DOOR MAY BE USED IF DESIRED TO LIMIT OPENING
FRONT OF HOOD BUILT UP TO CONTAIN PRESS CAKE AND CLEANING LIQUID
FILTER LEAVES ARE REMOVED MANUALLY AND CLEANED WITHIN HOOD

Fig. 6: *Effective control may be obtained by enclosure of the entire cartridge filter within a ventilated hood. Storage of used cartridge in hood can be accommodated.*

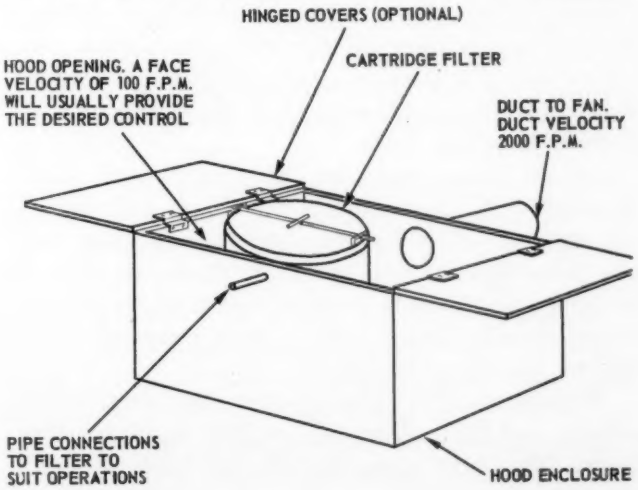

HINGED COVERS (OPTIONAL)
CARTRIDGE FILTER
HOOD OPENING. A FACE VELOCITY OF 100 F.P.M. WILL USUALLY PROVIDE THE DESIRED CONTROL
DUCT TO FAN. DUCT VELOCITY 2000 F.P.M.
PIPE CONNECTIONS TO FILTER TO SUIT OPERATIONS
HOOD ENCLOSURE

Fig. 1: *At the A-C Spark Plug Plant in Flint, Mich., operators select their own comfort level by manipulating dampers at their work station. Cooling chambers following glass seal furnaces provide the heat, which would otherwise be wasted.*

# 6 Ways To Recover Heat In Factories


**by R. N. Becker***
***Industrial Ventilation Engineer***
***AC Spark Plug Division***
***General Motors Corporation***


*Mr. Becker has been with the AC Spark Plug Division of G.M. for the past nine years. For the past two years he has been specializing in plant air conditioning, ventilating, dust collection and air distribution problems. He has spent three years at General Motors Institute in electrical engineering, and has had extensive general engineering experience, as well as air engineering background.

Where there's internal heat gain there's usually a way to recover heat. Where there's air exhausted there's often a way to squeeze out heat. Here are some of these ways, by an air engineer who's done it.

THERE ARE MANY practical ways to eliminate problems of negative pressure due to an insufficient supply of make-up air, and at the same time reduce overall plant heating costs. We at AC Spark Plug Division, Flint plant, have successfully utilized a number of methods of squeezing heat from machines and processes . . . heat which would, otherwise, have been either wasted to atmosphere or trapped in ceiling areas.

At the same time, we have eliminated major areas of negative pressure with all of their attendant problems of cold drafts, hard-to-open doors, and dirt infiltration into the plant. Further, our plant is far more comfortably heated, which improves employee morale, and we have made substantial savings in fuel consumption.

Here at the Flint plant, we employ about 12,000 people, and have about 3½ million sq. ft. of floor space. We make some 35 different kinds of products in thousands of variations, including spark plugs, fuel pumps, auto instrument panels, oil filters and their elements, and various items of electronic equipment.

The total heat supplied to the AC Dort Highway operation by gas, steam and electricity in the year 1958 totalled 2,023,359,000,000 Btu, (enough to heat 100,000 homes in the Detroit Area a full heating season). The total calculated space heating requirements for these buildings amounted to 482,541,000,000 Btu. 2,023,359,000,000 – 482,541,000,000 = 1,540,818,000,000 Btu, a substantial part of which could conceivably be reclaimed and utilized to heat make-up air to replace exhausted air and relieve building negative pressures. These are round figures; we could not hope to re-use even half of this heat, but the fact that our space heating requirement is less than one fourth of the total bill seems significant.

We attacked the problems of eliminating negative air pressure and conserving heat in three ways:

(1) Close control over design of all new process equipment as well as all rearrangement of existing equipment. For example, all purchase orders and work orders are routed over the ventilation engineer's desk for his approval. At this stage, we are then able to detect ways and means of saving heat and make-up air and provide for proper ventilation, *before* major installations or alterations are made.

Fig. 2: *Designing dampers into an original installation which permits combinations of intake, exhaust and recirculation, pays dividends on many industrial process machines.*

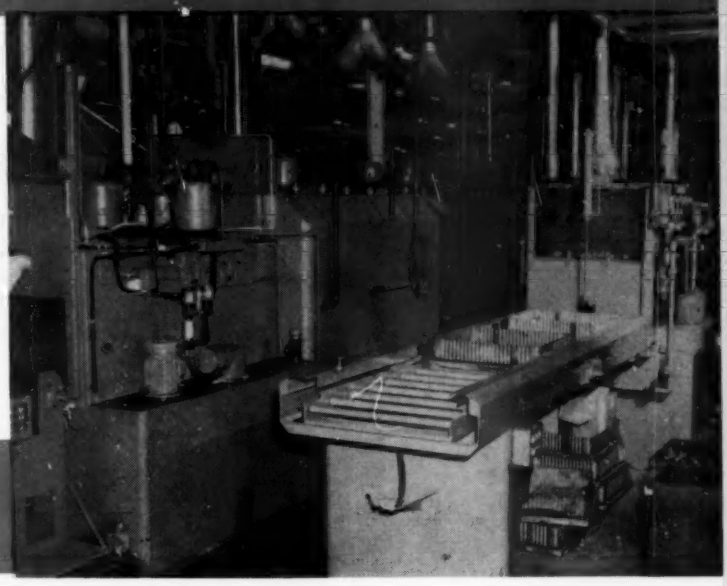


Fig. 3: *Gas-fired heat treating furnaces can deliver great quantities of heat for comfort ventilation and process applications. This type of furnace burns gas under essentially the same conditions as line burner make-up air units.*

(2) Frequent plant-wide surveys to detect promiscuous use of exhaust equipment, and to devise ways and means of reducing excessive waste of air pressure and Btu. These surveys also help bring to light new ideas for heat conservation.

(3) Periodic sessions with production supervisors and process engineers, to impress upon them the important of heat conservation and to enlist their aid in this area.

Let us now consider five "case histories" dealt with at our Flint plant.

## Case History No. 1

This is a production process which washes, dries, paints, and cools oil filter shells. Fig. 6 illustrates this process, and gives exhaust and supply air figures. In this instance, we have applied a number of our heat conservation principles. We have reduced the air exhaust volumes well below accepted standards by evaluation of actual requirements rather than by applying a rough "rule of thumb."

Basic principles involved are:

(1) Sealing off the washer with a high velocity curtain.

(2) Supplying outside air to a turbine type blower, where the friction of turbine vanes raises temperature of the air to near room temperature, at 0° outside.

(3) Returning heated air from the cooler to the building in winter, with dampering for exhausting in summer.

(4) Reducing effective opening of the strip tank by hooding the conveyor.

(5) Routing warm air from the cooler through the oven to reduce the gas required to heat the oven.

It may be noted that we did not succeed in making up all of the air exhausted, but since heat is radiated from the equipment in the area, we were able to install reversible window fans to make up the balance in winter and remove heat in summer. Calculating heat from equipment shows that this source of make-up air would not require tempering.

## Case History No. 2

Here is an example of detecting a possible savings by survey. In the original installation (Fig. 7), blower No. 1 supplied cold air to the cooler and blower No. 2 exhausted heated air to the outside. No other control of cooler air was provided. Our problem was threefold: (1) In winter, cold air spilled out at the cooler load station, creating an operator comfort problem; (2) heated air was discharged to the outside, wasting heat, and (3) temperatures above the platform remained high the year around, because of adjacent electrical equipment and a nearby glass seal furnace.

We solved our problem in this manner. First, we installed a damper at discharge (A), so that the operator could control cold air in the cooler. Excess cold air cools the area directly above the platform. Discharge damper at B was installed to release heat to the outside for hot weather operation; discharge outlet C was provided to return heat obtained from the cooler to the building during cold weather operation. Blowers 1 and 2 are wired to run simultane-

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Fig. 4: *Heat generated in kiln firing ceramic ware, offers a tremendous source of uncontaminated "free" heat which can be used in many ways to accomplish savings.*

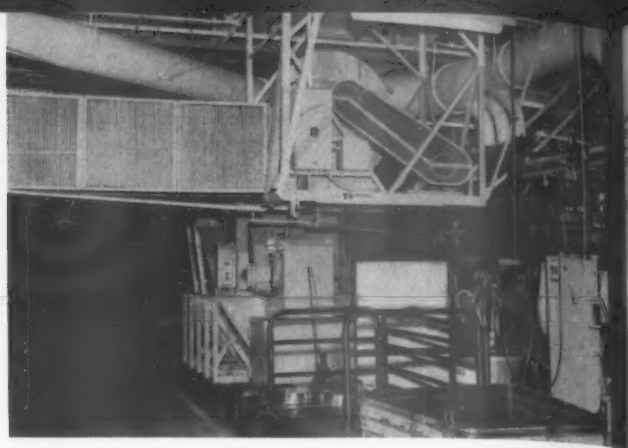


Fig. 5: *Use of water wash dust collectors gives excellent results in cleaning collection air (Case History No. 5) from mechanical buffing of zinc parts prior to copper-nickel-chrome plating. This equipment shows substantial savings in heating steam, in that it operates on 100 percent recirculated air. It has the added advantage of providing evaporative cooling in summer and humidification in winter.*

*(Continued from preceding page)*

ously. The results of the operation are impressive: 33,000 cfm of exhaust eliminated, 33,000 cfm make-up air supplied to the building. Cost of converting 11 coolers: $2068. Savings: $6100 per year.

*Evaluation of savings was made according to this formula:*

Btu/hr=(Wt. of Std. Air/cf) (Specific heat) (cfm)(60)($T_1$-$T_0$)

Cost of steam=$1.25/1000 lbs. Condensed=$.25/1,000,000 Btu

*Which reduces to:*

$$\frac{1.08 \times \text{cfm} \times (70° - 35°) \times \$1.25}{1{,}000{,}000} = \$ \text{ Savings/hr.}$$

The figure of $1.25/1000 lbs. of steam condensed is arbitrary since it represents the total cost of the power house operation and the actual savings of 1000 lbs. may be less than this figure. However, any other figures would also be debatable, and we use $1.25 to establish relative savings only.

Since Fig. 7 thus is self-explanatory, we may pass on, except to mention that the success of this project relieved a serious heating problem in the spark plug plant with a relative small expenditure and reduced our steam load. It might also be noted that such substantial savings can be made by application of a simple principle:

Cost $2,068 – Savings $6,100

## Case History No. 3

This case history is similar to Case Two, except that the furnace which supplies the heat is in an area which is already over-heated, so it was necessary to carry the heat into another area. This installation represents what we feel to be the ultimate in the use of reclaimed heat, where the "free heat" is used in conjunction with an existing unit heater as a "preheater." The source of heat used is the exhaust from two batteries of radiant gas burners heating a heat-treat furnace.

The sequence of operation (Fig.8) is:

(1) With outside air temperature above 70°, thermostats (Fig. 8) $T_1$, $T_2$, and $T_3$ are satisfied. Outside air intake louvers (F-A) are open, recirculation air louvers are closed; damper D-1 is open, damper D-2 is closed, and M.V. is closed.

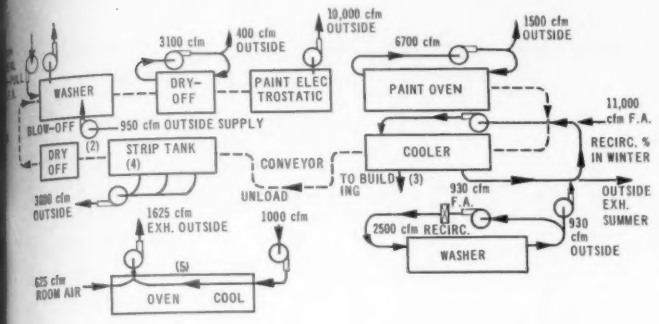
(2) A drop in outside air temperature below 70° actuates $T_3$, which modulates motor (M-2) to open damper D-2, and close damper D-1, maintaining a 70° temperature in the plenum of air handling unit.

(3) When a further drop in outside air temperature causes air mixture in plenum to drop below 70°, with D-2 fully open and D-1 fully closed, discharge air will drop below 70° and $T_1$ will modulate M-V to maintain 70° discharge.

(4) If a further drop in outside air temperature should cause discharge air to drop below 65° with M-V fully open, $T_2$ thermostat will modulate M-1 motor, opening recirculation air louvres and close fresh air louvres to maintain 65° discharge air.

The combustion products of gas from the heat-treat furnace are well below the maximum allowable concentration. Dilution at burner hoods is 6:1 air to gases, and the mixing at the unit heater is an additional 2:1; therefore no problem exists from contamination. This installation went into operation at the beginning of 1959 heating season. To date, there has been no adverse report.

Since the unit heater and controls were existing and it was necessary to remove the heat from the gas burners, only the cost of the ductwork can be charged to the economic evaluation of the installation. Cost of additional ductwork: $432. Savings: $4,785 per year.




| ITEM | SUPPLY | EXHAUST | BLDG. POS. | BLDG. NEG. |
|---|---|---|---|---|
| Washer | 930 cfm | 930 cfm | .. | .. |
| | Air Seal | | | |
| | 1800 cfm | 1800 cfm | .. | .. |
| Washer | Blow-Off | | | |
| | 950 cfm | | 950 | |
| Dry-Off | .. | 400 cfm | .. | 400 |
| Paint-Booth | .. | 10,000 cfm | .. | 10,000 |
| Paint Oven | .. | 1500 cfm | | 1500 |
| Cooler | 11,000 cfm | .. | 11,000 | .. |
| Strip Tank | Tank | 3600 cfm | .. | 3600 |
| | Dry-Off | .. | .. | |
| Oven | 1000 cfm | 1625 cfm | .. | 625 |
| | | | 11,950 | 16,125 |

## Case History No. 4

Fig. 9 involves routing heat from one process to another to accomplish savings. Here the waste air reused is contaminated with smoke, so as to render it inacceptable for building heat. However, in the immediate vicinity were two platers, each of which required hot air to dry off the plater baskets prior to loading. As the drawing shows, this had been done with steam coils.

A study revealed that the waste heat available was ample to satisfy the drying station. Since the dryers were inside the plater enclosure which has a high efficiency ventilating system, the contamination of the waste air is no problem, because it will be exhausted to the outside without coming in contact with the personnel.

Applied to two furnaces and two platers, this accomplished savings of $3,190 per year, with a cost of $986.

## Case History No. 5

As a basic principle we try to install return air collectors with dust producing processes. For example, in the case of the production buffing units, we have installed air recovery units to extract usable heat from dust-laden air (in this case, orifice type air washers). These collectors also impart some sensible cooling to the area during summer.

Using the formula in Case History No. 2, the buffing units involved 20,000 cfm @ .945¢/16 hr. day, which equals $15.12/day savings. Air recovery units cost $8,207, plus $5,000 installation costs. At $15.12/day/190 working days, savings = $2,872 per year. Equipment life expectancy is 20 years, so amortization will be accomplished well before end life.

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Fig. 8: *Here heat is reclaimed from radiant gas burners (Case History No. 3) to save $4,785.00 per year, at a cost of only $432.00 for additional ductwork.* →

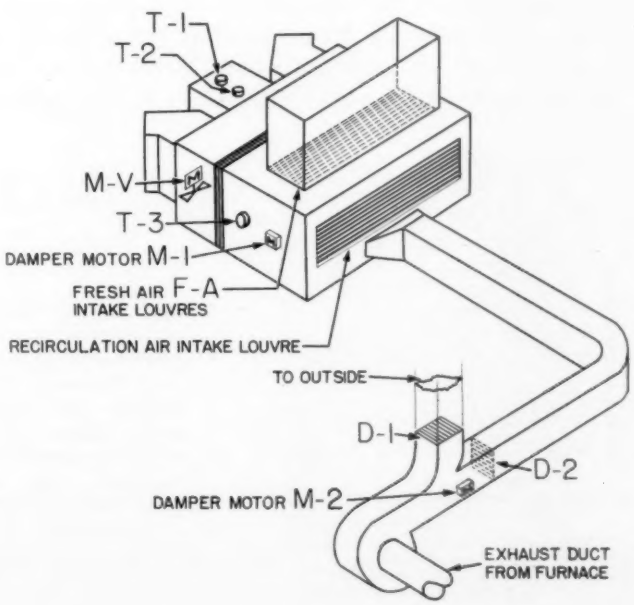



Fig. 6: *This production process (Case History No. 1) washes, dries, paints and cools oil filter shells. Heat conservation methods have used heat gains from these processes to heat other plant areas. See chart under Fig. 6.* ←

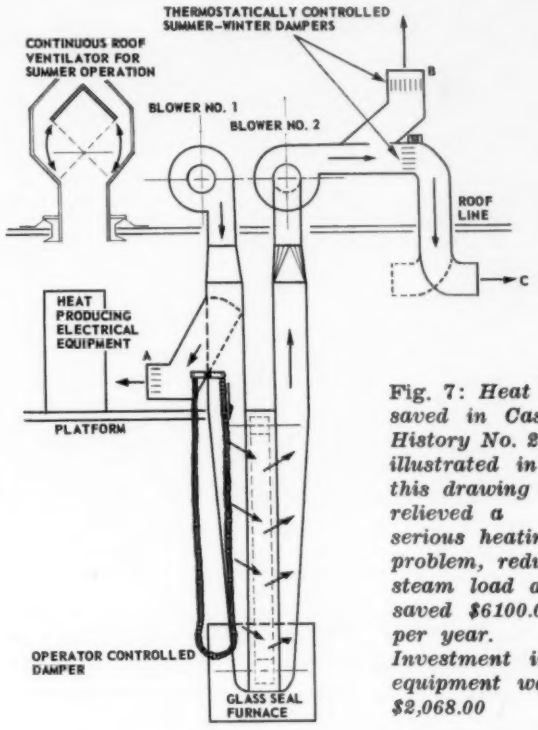



Fig. 7: *Heat saved in Case History No. 2, illustrated in this drawing relieved a serious heating problem, reduced steam load and saved $6100.00 per year. Investment in equipment was $2,068.00*

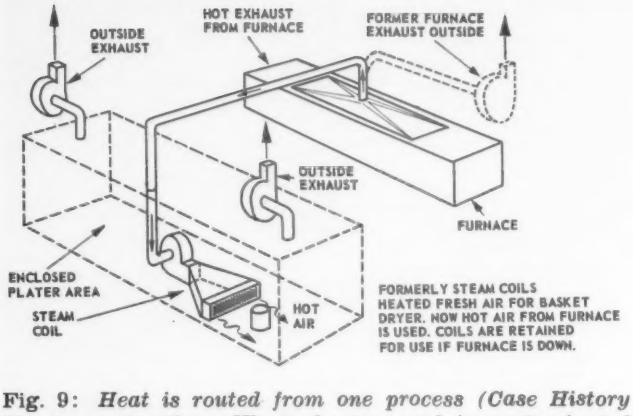

OUTSIDE EXHAUST
HOT EXHAUST FROM FURNACE
FORMER FURNACE EXHAUST OUTSIDE
OUTSIDE EXHAUST
FURNACE
ENCLOSED PLATER AREA
STEAM COIL
HOT AIR
FORMERLY STEAM COILS HEATED FRESH AIR FOR BASKET DRYER. NOW HOT AIR FROM FURNACE IS USED. COILS ARE RETAINED FOR USE IF FURNACE IS DOWN.

**Fig. 9:** *Heat is routed from one process (Case History No. 4) to another. Waste heat reused is contaminated with smoke. Waste heat was used to dry off plater baskets.*

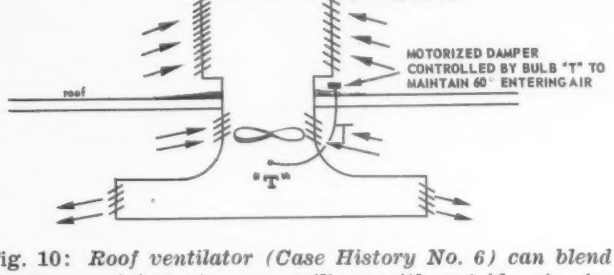



**Fig. 10:** *Roof ventilator (Case History No. 6) can blend the layer of hot air near ceiling, with outside air, for comfort tempering.*

*(Continued from preceding page)*

## Case History No. 6

An inexpensive roof mounted (Fig. 10) unit can blend a layer of hot air below the ceiling with outside air, to introduce air for comfort tempering at a low level, as a source of make-up air. A filter box in the roof leads into modulating dampers controlled by a bulb below the blower. Manually adjustable dampers bleed in fixed quantity of hot air at ceiling level. With outside air quantity regulated as needed, the unit delivers 68° filtered air to working zones. These units can pay for themselves when installed near a source of heat at ceiling levels, as for instance, near a heat treating furnace. Unit provides

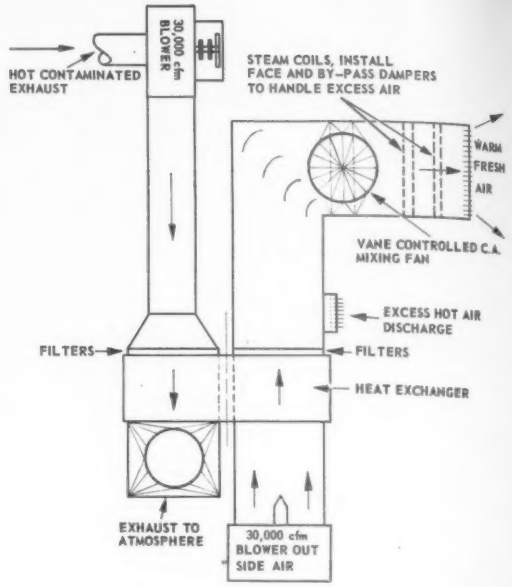



**Fig. 11:** *An air-to-air heat recovery wheel will be installed this Fall, as shown in this schematic drawing. The wheel blends outside air to maintain a constant make-up air temperature.*

filtered, tempered air throughout the year, and serves for summer ventilation with manual dampers closed and outside air damper wide open.

## FUTURE PLANS

Figs. 11, 12, and 13, deal with some of AC's plans for the future. We have done research on the potential use of air-to-air heat exchangers (heat recovery wheel) and at present are installing such a unit.

Fig. 11 shows the schematic layout of this equipment. It becomes immediately obvious that the use of a heat exchanger poses some control problems, inasmuch as the exhausted air is of a relatively constant temperature and the outside air is of a widely varying temperature, which if ignored would result in varying return air temperature.

We have considered two basic approaches. One, to blend outside air with the exhaust air to main-

*(Please turn to page 54)*

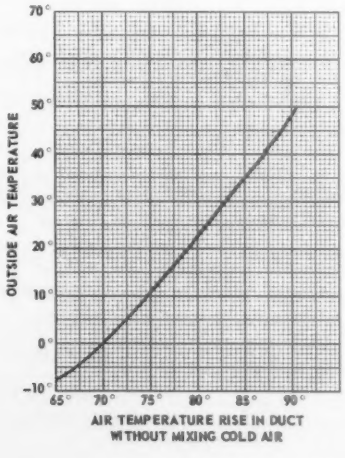
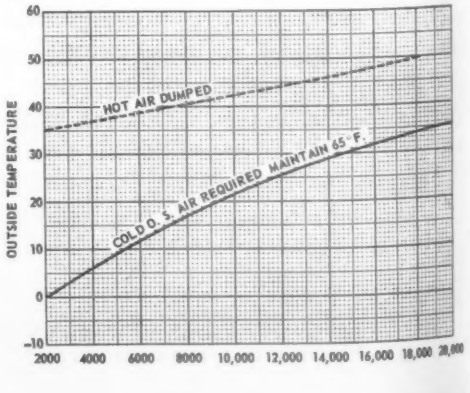



**Fig. 12:** *Graph shows rise in outside air temperature in a duct bringing make-up air to a building, if no attempt at control were made, as related to Fig. 7.* ←

**Fig. 13:** *Graph shows volumes of outside air which must be introduced downstream of the heat recovery wheel at rising outside air temperature, and point where heated outside air must be spilled to prevent temperature rise above control point. See Fig. 7 for schematic of installation.* →



*Engineering fundamentals of*

# *Air Sanitation With Ultraviolet Light*

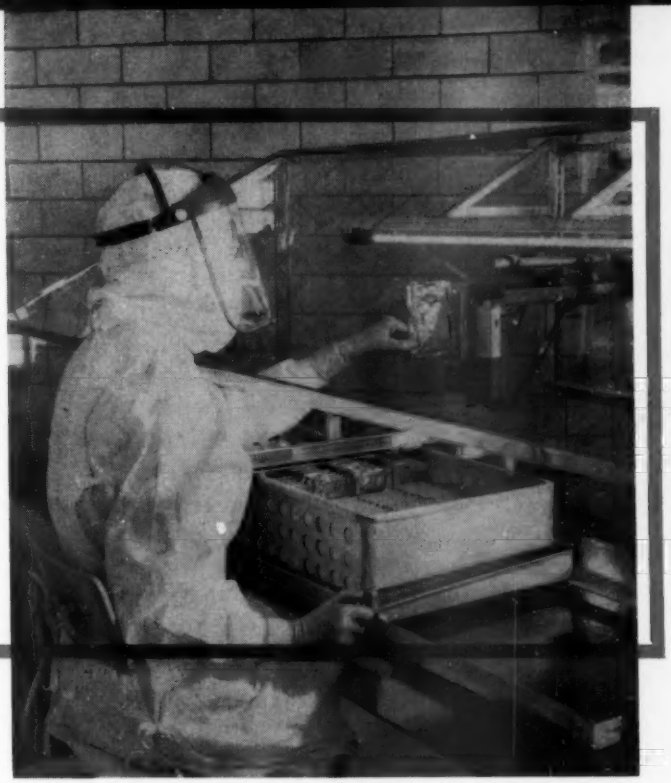


Fig. 1: *A package sealing operation in a pharmaceutical plant is performed under a sterile hood. Note germicidal lamp directly over the package.*

**Part II**

At last, a practical engineering guide on application of ultraviolet light for air sanitation in schoolrooms, bakeries, pharmaceutical plants, meat packing, wherever air should be sterile. Factual data on installation in air conditioning systems, air flow, location, lamp selection, will be included.

**Last month, the application of ultraviolet light for air sanitation of schoolrooms, bakeries, pharmaceutical plants, and meat packing industries was discussed. Data on installation in air conditioning systems, air flow location, and lamp selection were given.**

In 1942, Professor F. W. Wells, then of the University of Pennsylvania, reported on a four year study of the application of ultraviolet radiation in schools. Results showed that the radiation greatly reduced the classroom spread of measles and chickenpox and, to a small extent, mumps.

In his experimentation in the Germantown Friends School in Philadelphia, Wells noted that during a measle epidemic, four times as many students were infected in schoolrooms without ultraviolet compared with the irradiated rooms. At Swarthmore, Pennsylvania, ultraviolet was installed

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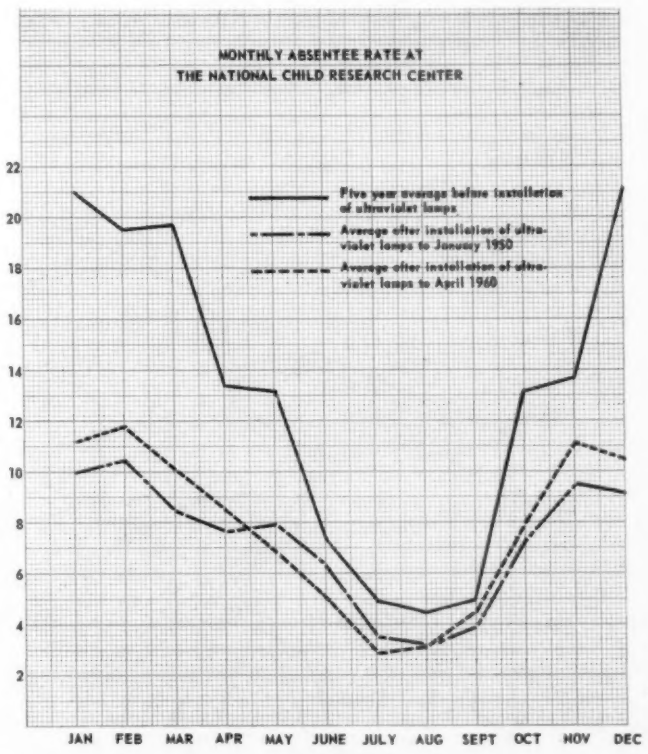



by J. C. Hoffman, *Commercial Engineering Dep't.*, and R. Nagy, *Ph.D., Research Dep't., Lamp Division, Westinghouse Electric Corp.*

®—*U. S. Patent Office*

*(Continued from preceding page)*

in the primary schools where the attack rate of measles had been six times as heavy as in the high school. Following an ultraviolet lamp installation this attack rate was reversed sharply. Only one-third of the cases were in the more susceptible lower grades groups.

A more comprehensive study of air irradiation was started in 1943 at the Camp Sampson Naval Training Station in New York. Germicidal lamps were placed in sleeping quarters only and located so as to irradiate both the upper air of the barracks and under the bunks. It was felt that the hours of sleep were most important in the transfer of respiratory infection. After two years Wheeler and his associates reported a 25 percent reduction of respiratory illness in the irradiated barracks as compared with adjacent control barracks. With the closing of Camp Sampson at the end of the war, the tests were continued at the Great Lakes Naval Training Station. In 1948 Miller and his co-workers recorded a 19.2 percent reduction in total respiratory disease.

With mounting evidence of the effectiveness of ultraviolet it was deemed desirable to locate those areas in the entire community which added most to the breeding of contagion. In 1946 two towns in Westchester County, New York, were selected for a study. In the town of Pleasantville, schools, Sunday schools, churches, clubs, the theatre, certain stores and other places of assembly of children were irradiated with germicidal lamps. Mt. Kisco, a neighboring town, served as the unirradiated control. In 1950, at the end of a four year study there was a definite reduction in the total cases of measles and chickenpox in Pleasantville as compared to Mt. Kisco. But most important, the pattern of spread was also changed.

Although the reduction of disease was not spectacular in this test, the following excerpt from M. W. Wells and Holla is significant: "The age group 0-9 years has both in Pleasantville and Mt. Kisco contributed most of the cases of measles and chickenpox. Slightly over one-third of the cases have been in pre-school children. In Pleasantville, 51.2 and in Mt. Kisco 60.3 percent of the cases were in the kindergarten to fourth grade group." Although the number of children infected in the home was slightly greater in unirradiated Mt. Kisco, the number infected in the school was almost three times greater. In Pleasantville almost twice as many were infected in the home as in the school.

The value of ultraviolet in a schoolroom is perhaps best displayed in the continuous test conducted at the National Child Research Center in Washington, D. C., with a nursery and kindergarten of children under 6 years of age. Because of the nature of its activities, the Research Center has kept an accurate record of absenteeism and its causes since 1940.

In 1945 the Center principals decided to test the efficiency of the STERILAMP® tube in reducing airborne diseases. Lamps were installed in December, throughout the entire school and absentee rates due to respiratory disease were averaged for the previous period from 1940-1945. A reduction in absentee-

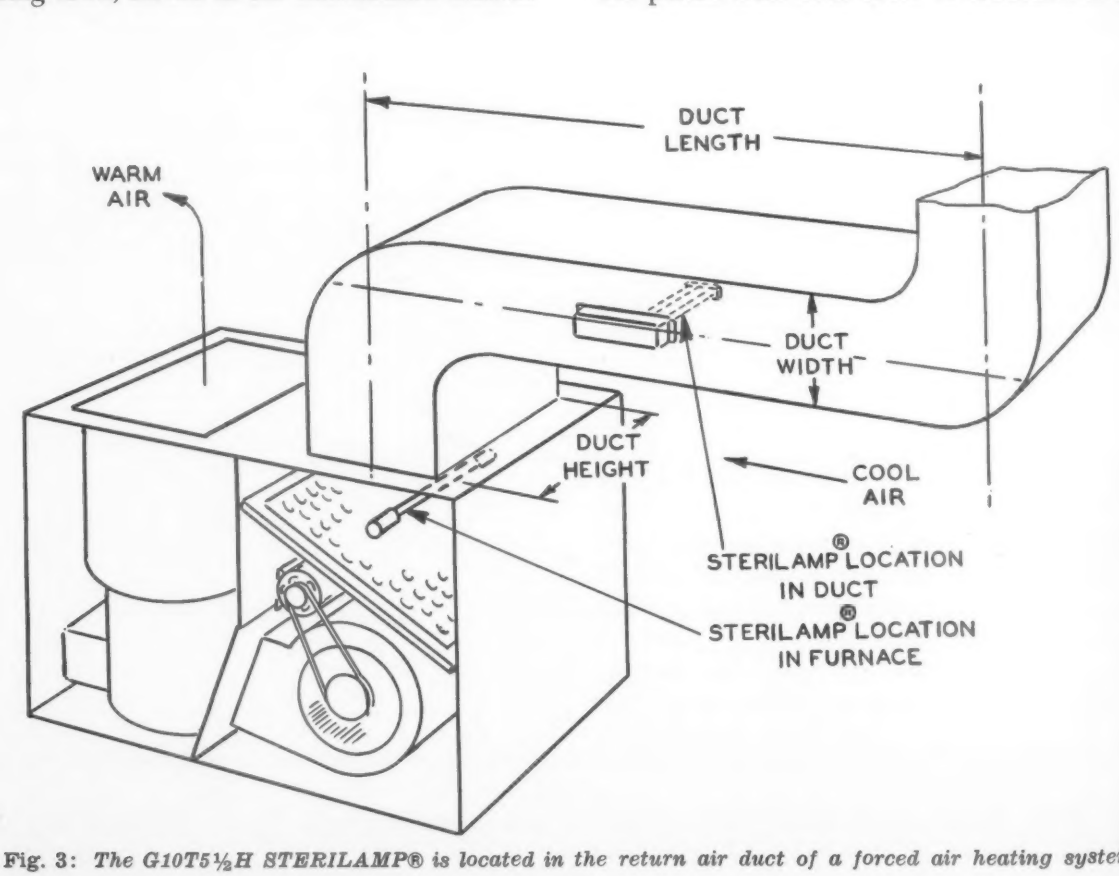



**Fig. 3:** *The G10T5½H STERILAMP® is located in the return air duct of a forced air heating system.*

ism was noticed immediately. From Fig. 2 it may be seen that germicidal conditioning reduced absenteeism over the first four year period by about 45 percent during the winter months. Over a thirteen year period to September 1959 this reduction averaged about 40 percent.

It is not at all surprising that such a reduction in contagion is possible through the use of bactericidal lamps. The list of respiratory diseases carried by airborne organisms, is imposing indeed, including among others: tuberculosis, diptheria, chicken pox, scarlet fever, mumps, measles, pneumonia, septic sore throat, influenza and common cold. An unchecked sneeze or cough by any child will project these bacteria and virus 25 ft. – quite sufficient to infect teacher and pupils in the average classroom. According to the surgeon general's records of the U.S. Army, 35 percent of all illness in the army camps during a one year census was from respiratory infections.

It is important to note here that the number of lamps required for a favorable effect in schoolrooms is critical. From time to time tests have been run in this country and England which did not substantiate the studies of Wells and others. In every case where a reduction of respiratory illness could not be shown, ultraviolet intensity in the classroom was found to be very low.

A school room should employ one G30T8 or equivalent germicidal lamp for every 200 sq. ft. of classroom area. The lamps should be cleaned and checked periodically and replaced when ultraviolet output drops below 70 percent of the initial lamp rating.

It should be remembered also that the STERI-LAMP® tube is an aid to preventive medicine. It will not replace school nurses or hygienic conditions but will complement these efforts and provide a great stride forward in the alleviation of human suffering.

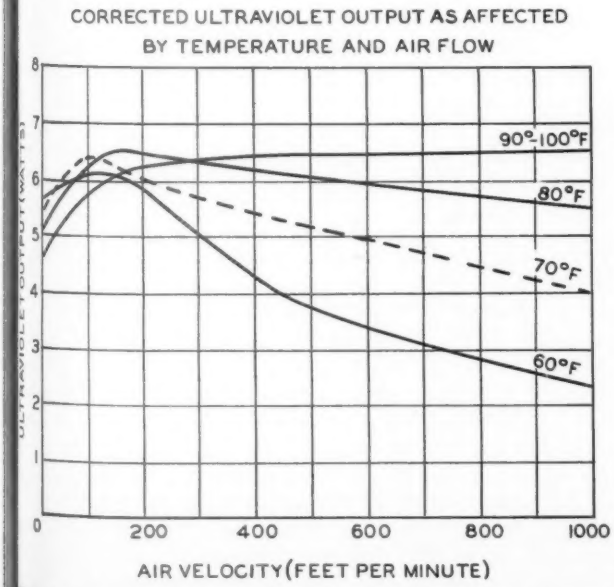



Fig. 4: *Corrected lamp output may be computed from this table.*

## Small Commercial & Residential Forced Air Systems

From time to time various manufacturers have attempted to apply the benefits of ultraviolet lamps to home and office. In the late 1940's the small Odorout® lamp gained acceptance in wall mounted fixtures. But this lamp, utilizing the generation of ozone, served primarily as a deodorizer. Today the same lamp continues to enjoy success in the home, now in table type units with a fan located behind the lamps to better circulate the ozone throughout the room. However, the small Odorout lamp, even when three of them are employed, is only slightly effective against airborne bacteria.

Larger germicidal lamps used in commercial and industrial applications were too cumbersome to be used in the confines of the small commercial or residential forced air systems. Even if a suitable lamp were available, a need for air disinfection had to be proved to the home owner. Asian Flu provoked this need in the home.

In 1957 the disease reached epidemic proportions, causing many schools to be shut down and absentee rates to rise in factories and offices. To

*(Please turn to page 53)*

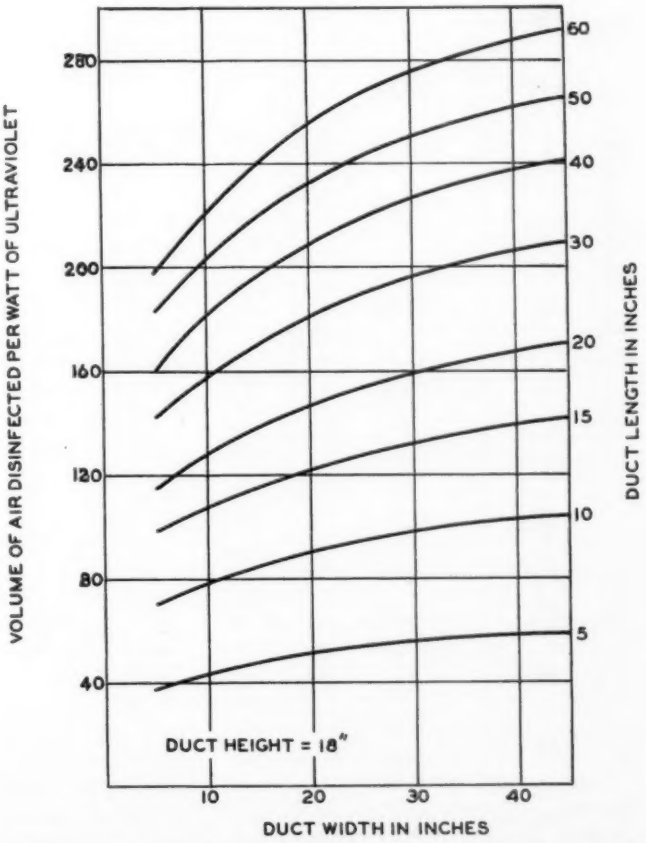



Fig. 5: *Volume of air disinfected per watt of ultraviolet light.*

# NOMOGRAM FOR DENSITY OF MOIST AIR

## Nomogram . . .

By F. Caplan
*Kaiser Engineers, Oakland, Calif.*

In the range of most engineering temperatures and pressures, moist air follows the perfect gas law to within approximately 0.1 percent:

$$BVM = WRT \quad (1)$$

where B = absolute pressure; inches of mercury
V = volume, cu. ft.
M = average molecular weight of mixture, lbs. per lb. - mol
W = lbs. of mixture
R = universal gas constant, 21.85 in. Hg, cu. ft. per lb.-mol, deg. Rankine
T = absolute temperature, °R, = t + 460
t = temperature, degrees Fahrenheit

Therefore, density, lbs. per cu. ft.

$$\rho = \frac{W}{V} = \frac{BM}{21.85\ (t + 460)} \quad (2)$$

The average molecular weight of a mixture of gases is equal to the sum of the weights of each component divided by the sum of the mols of each component present:

$$M_{ave.} = \frac{W_1 + W_2 + \ldots}{\frac{W_1}{M_1} + \frac{W_2}{M_2} + \ldots} \quad (3)$$

For a mixture of air and water vapor,

$$M_{ave.} = \frac{W_w + A}{\frac{W_w}{18.02} + \frac{A}{28.97}} \quad (4)$$

where $W_w$ = lbs. of water vapor
A = lbs. of dry air

Dividing numerator and denominator by A:

$$M_{ave.} = \frac{\frac{W_w}{A} + 1}{\frac{1}{18.02}\cdot\frac{W_w}{A} + \frac{1}{28.97}} \quad (5)$$

But $W_w/A$ is the absolute humidity, H. Substituting H and multiplying top and bottom by 29 :

$$M_{ave.} = \frac{28.97\ (H + 1)}{1.61\ H + 1} \quad (6)$$

Substituting eq. (6) in (2) :

$$\rho = \frac{1.327\ .\ B\ .\ (1 + H)}{(t + 460)\ (1 + 1.61\ H)} \quad (7)$$

The accompanying nomogram is a graphical solution of eq. (7).

# ? ? ? ? ? ? ? Questions & ANSWERS ? ? ? ? ? ? ?

### Data on Tar Deposit Prevention

*We have a problem in fumes removal and a resultant deposit on ducts for which we are trying to find a solution.*

*We have a room in which we heat small tar tanks to temperatures ranging from 200° F. to 300° F. The tar solutions are mixtures of RT9, coal tar pitch and Trinidad asphalt. In order to minimize the tar fumes in the room we have hoods over each individual tank, and four tanks in a group are joined to a vertical stack which passes through the roof. The branches are about 7" diameter and the stacks 14" diameter.*

*There are a total of twenty such stacks and they do a satisfactory job of keeping the fumes from the space. The major problem is from naphthalene crystals which deposit on the interior surface of the pipes. This is not only a fire hazard, but it is also difficult to clean the deposits from the pipes.*

*We have been removing all the pipes on an annual basis for cleaning, but this is a lengthy process and should be done even more frequently. Have you heard of a similar problem?*

*C.J.C.,*
*Newington, N. H.*

**Answer:**

The naphthalene has a melting point of 176°F and a boiling point of 425°F. At the tar tank temperatures of 200° to 300°F considerable nephathalene is vaporized and disseminated in the air directly over the tar bath surface. This air contaminated with tar fumes and naphthalene is then carried up the stack into the main stack, where the naphthalene vapor is cooled to a temperature below 176°F, the naphthalene vapor then sublimates to form the crystal particulates.

It is possible because the stack surface is cooler than the air stream temperature, that more sublimation takes place here, also the cooler surface attracts the particles similar to the principle of operation of the thermal precipitator.

It is assumed from the information given that the system is a natural draft system where the airflow is effected by a difference in thermal head. However, if it is a centrifugal fan system a water wash type collector will be effective in moving the crystals as the cooling of the air stream by water spray will convert the naphthalene in vapor phase to the particulate matter form (solid phase)

*(Please turn to page 51)*

# News of the Industry . . .

*(Continued from page 14)*

## Odor Control Installation Proves Effective

The Western Kraft Corp. has announced the completion of a new odor control installation at its Albany pulp and paperboard mill. The unit completes a program of odor control costing in excess of $300,000 which the company began in 1955.

An odor survey in the Albany area conducted August 31 by the Air Pollution Control Division of the State Sanitary Authority showed a marked improvement in area odor conditions.

### Georgia Dept. Of Health Releases Data

As part of its 1959 Annual Report, Georgia Department of Health, Division of Occupational Health, reported the following epidemiologic study as of June, 1959: Eight deaths related to silicosis; one to pneumoconiosis from kaolin dust; two deaths due to occupational lead poisoning; two deaths due to occupational asbestosis.

Seven new cases of lead poisoning were reported. One case of metal fumes fever and seven cases of carbon monoxide poisoning were reported.

### AP Listed As Cancer Cause

Air pollution was listed among five other environmental causes as a possible cancer agent in America by Dr. John R. Heller, president of Memorial-Sloan Kettering Cancer Center, N.Y. It was his opinion that cancer might well be cut 10 to 15 percent within ten years by eliminating environmental causes.

### *British Cancer Club*

From across the waters: A British doctor reports that he is going to form a club for sufferers of lung cancer to force the government to control Britain's smog.

Sir Walter Fergusson said he hoped such a club would persuade officials to launch a full-scale research program.

### FREE WHITE ROOM PRODUCT CATALOG

A Special Service: AIR ENGINEERING is offering free to its readers a list of approximately 100 names of manufacturers of Super-Clean and White Room equipment and supplies. List includes sources for furniture, floor covering, special filters, paint, enclosures, shoe cleaning equipment, air locks and white room controls and instrumentation.

Those wishing to receive this list are requested to use the Communication Card on page 35 . . . ask for "White Room Directory."

### *Detroit Launches Extensive AP Program*

As part of a Detroit air pollution research program, 2000 animals will be exposed to air collected on a busy downtown intersection. The study, conducted by Wayne State University, with U.S.P.H.S. approval, is to determine the possible long-term effects of exposure to air pollution.

Slated to start next spring, the study is to last from three to five years. Air collected will be pumped direct to the animals.

### Same Little Man— Different Tactics

Premier Nikita Khrushchev switched from politics to air pollution momentarily as a topic for conversation during his recent New York visit.

Mr. K, aboard the *Baltika,* took several lungfulls of Manhattan air and declared, in his inimitable manner, that the city would do well to follow the Soviet example and switch to gas.

### Timken Handles AP Problem

Timken Roller Bearing Co. has been trying to solve smoke problems at its Canton, Ohio plant since the end of World War II. As a further step in that direction $150,000 has been appropriated for a smoke and dust control unit, bringing the total cost spent thus far to $500,000.

Timken says that, should the unit prove efficient, two more will be acquired.

### New Consulting Engineers

Edwin G. Siegel, formerly chief mechanical engineer of Minoru Yamasaki & Assoc., Birmingham, Mich., has announced the formation of E. G. Siegel Assoc., Consulting Engineers, with offices in Detroit, Mich.

STATEMENT REQUIRED BY THE ACT OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, JULY 2, 1946 AND JUNE 11, 1960 (74 STAT. 208) SHOWING THE OWNERSHIP, MANAGEMENT, AND CIRCULATION OF

Air Engineering published monthly at Detroit, Michigan for October 1, 1960.

1. The names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Business News Publishing Company, Detroit, Michigan.

Editor, Eugene A. Sloane, Birmingham, Michigan.

Managing editor, Eugene A. Sloane, Birmingham, Michigan.

Business manager, Edward L. Henderson, Birmingham, Michigan.

2. The owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual member, must be given.)

Business News Publishing Company, Detroit, Michigan.

Helen C. Henderson, Birmingham, Michigan.
George F. Taubeneck, Grosse Pointe, Michigan.
Phil B. Redeker, Detroit, Michigan.
Robert M. Price, Hillsdale, New Jersey.
C. Dale Mericle, Traverse City, Michigan.
Walter J. Schuler, Detroit, Michigan.
Edward L. Henderson, Birmingham, Michigan.
John O. Sweet, Detroit, Michigan.
P. Allen Schildhammer, Grosse Pointe, Michigan.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.)

None.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: (This information is required by the act of June 11, 1960 to be included in all statements regardless of frequency of issue.)

5,576.

Edward L. Henderson,
Business Manager

Sworn to and subscribed before me this 3rd day of October, 1960.

[SEAL] Terry Kuhn Treiber
Notary Public, Wayne County, Michigan
(My commission expires December 31, 1963.)

# Tips for Sanding Machine Dust Collection.. Methods

for efficient collection of dusts from wood sanding machines of all types.

by John E. Hyler

Left: *Care must be taken when designing dust collection systems for wood sanders. Woods with a sticky pitch tend to pack and abrasion is a constant problem.*

GREATER AIR VELOCITY is often required in blower pipes collecting dust from sanding machines than might be indicated by application of any rule of thumb.

It is true that cuttings removed from wood surfaces by abrasive grains are small and light, but this is not the only point to be considered. Some woods sanded contain at least a modicum of pitch. Cuttings removed from pitch-bearing woods have a considerable amount of adhesive attraction. They tend toward packing, with higher resistance to pull of air flow than they would otherwise have.

Moreover, at drum sander installations, sander dust must be vertically lifted through a considerable distance before entering the exhaust main, and fractionated abrasive is present in the sander dust to some extent.

Such fragments are particularly heavy in relation to their size. It is therefore important to make certain that velocity in branch pipes leading to the drum sander is adequate.

For most efficient removal of dust from a drum sander, specific factors in machine design must be carefully watched. These will either contribute to effective dust removal, where they have been given proper attention, or detract from it if they have been overlooked or ignored. Some modern machines, like the endless-belt drum sanders, have been designed carefully with reference to this specific point.

## Four Sanding Drums; Five Exhaust Hoods

For instance, these machines are always provided with a number of exhaust hoods exceeding by one the number of drums with which they are fitted. This allows placement of one exhaust hood in front of the first sanding drum, one behind the final drum, and one between each two drums in the layout. What is meant can be observed in Fig. 1, where a four-drum endless-bed machine is fitted with five exhaust hoods.

Such an arrangement not only provides greater dust-exhausting capacity for the machine as a whole, but is particularly strategic in the relationship of hood and drum positions. Each horizontal drum does its actual cutting at the bottom, and throws the cuttings in a slightly upward direction from underneath, as sanding proceeds.

If each sanding drum were provided with a hood directly above it, it would be necessary for cuttings to follow a somewhat tortuous course, first traveling through approximately 180° around the drum, then

*(Please turn to page 54)*

# *Rheem's Air Conditioning Highlights*

Here are some "tips" on air conditioning for critical and non-critical areas from Rheem Semiconductor plant.

AIR CONDITIONING at Rheem Semiconductor Corp.'s new $1.6 million electronics test and assembly plant, where silicon semiconductors are manufactured in a dust-free environment, is designed to meet the requirements of both critical and non-critical areas.

Tabbed "air critical" are all but 14,000 sq. ft. of the 100,000 sq. ft., one-story, tilt-up concrete facility. This area includes the super-clean manufacturing and air-lock, seal-off areas. Items on the non-critical list are sales and executive offices which are air-isolated from the manufacturing area.

In short, all three areas, critical or non-critical, require individually designed air conditioning. Highlights on how Rheem's air conditioning problems were solved follow:

● Critical areas are sealed off from non-critical areas by six double-door, neoprene-gasketed air-locks, with ½ in. positive pressure held both in the locks and the 40,000 sq. ft. manufacturing area.

● To accommodate the myriad heat-gain processes, requiring a ton for every 200 sq. ft., eleven 50-ton, hermetically sealed refrigeration compressors (550-tons capacity) are used to eliminate power surges which would cause fluctuating line voltages to plant precision electronic equipment.

● Compressors are relay-delay, increment-start type, located in three equipment rooms isolated from the critical area. Each compressor comes on the line at 60 percent of its rated capacity.

● Ultrafine-filtered are some 173,580 cfm of conditioned air ducted into the critical area. Filters are dry synthetic fiber type, 85 percent efficiency DOP for particles smaller than one micron. For particles five microns or larger, filtration is 100 percent. Smoking is prohibited because submicron size of smoke particles exceeds tolerances.

● As diffusers vent more than a maximum 3700 cfm, and the majority are of a smaller capacity, there is no perceivable air flow, and this though some 173,000 cfm circulates the area.

● Temperature in the manufacturing areas is pegged at 77°F., ± 1½°. Humidity is held to ± 5 percent. In the 800-sq. ft. area devoted to "life tests" at the plant, electronic thermostats hold tolerances of ± ¾ of 1°, humidity to ± 2 percent.

● In general, single zone air handling units are thermostat controlled by room units. Each zone's supply duct is installed with a low-limit thermostat, this to maintain minimum discharge temperature during the heating cycle. Room thermostats control a single hot water valve whose special cam closes at approximately two-thirds through its stroke.

● During the cooling cycle, switches de-energize the low-limit thermostat in the supply duct and energize two sequential stages of solenoid valves at each zone air handling unit.

● Single zone control for super-critical test rooms is maintained by an electronic room thermostat, its operation identical to that of non-test area electric thermostats.

● Multi-zone air units are served by room thermostats in each zone. Thermostats control the position of their respective hot-cold plenum mixing dampers. Zone control for the Quality Control Lab, another super-critical area, is by electronic room thermostat with integral temperature adjustment. Otherwise, the controller operates as other such units. ▲▲

CREDITS

Design Engineering and Contractors . . . *William J. Moran Co., Alhambra, Calif.*

Installations . . . *Baker Engineering Corp., Los Angeles.*

EQUIPMENT

Diffusers . . . *Barber-Colman Co.*

"Dycon" CA-24 Filters . . . *Continental Air Filters, Inc.*

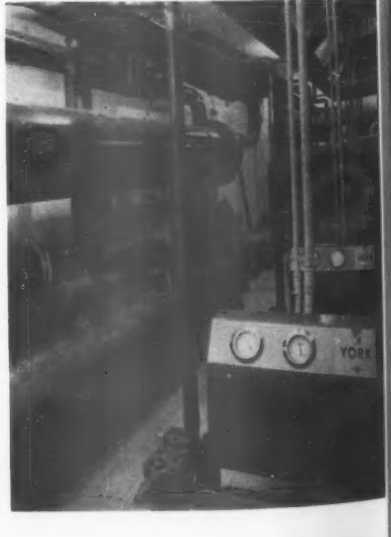
Multi-zone Fans and Coils . . . *Recold Corp.*

Induced-draft Cooling Towers . . . *Pritchard & Co. of California.*

Shell-tube Condenser, Freon Compressors . . . *York Div., Borg-Warner Corp.*

Hermetically-sealed Motors . . . *Westinghouse Electric Corp.*

Below: Equipment room with five 50-ton hermetic factory-package compressors.



## Q & A . . .

(Continued from page 47)

here it can be collected.

If high efficiency of collection is desired a wet collector of the fog nozzle type might be the choice. If the system is a natural draft system the stack draft or static pressure of the system will be generally lower than a centrifugal fan system. It will not be feasible therefore, to install collectors of high or medium static pressure loss as the airflow will be greatly reduced with resultant poor hood collection efficiency.

Metallic filters of aluminum or steel of low resistance if oversized may not greatly reduce the airflow if there is enough thermal head to overcome the filter resistance; they would be partially effective as the metallic surface with comparatively high specific heat would cool the air and cause the naphthalene to sublimate out as crystals similar to the deposition process in the duct surface.

If the filters have too much resistance; horizontal metal plates in the upper portion of hood staggered and located to keep the resistance to flow low would help reduce the quantity deposit in the main vertical ducts by causing deposition on the plates. The plates should be made so they can be readily removed for cleaning purposes.

### Desires Methods to Eliminate Rubber Particle Pollution

*We are manufacturing spray booths used chiefly in the ladies belt industry where latex is sprayed onto strips of leather in the form of a mist, since the purpose of the spraying is to obtain a slight tackiness so that a lining can adhere to the leather strip long enough for it to reach a sewing machine operator who stitches these two pieces together.*

*The area of the booth is 1800 cu. ft. and the exhaust fan is 18". The drawing power of the fan is about 125 lineal feet per minute over the frontal area of the booth. The spray gun used consumes about 1 cu. ft. of air/min.*

*The Air Pollution Board now claims that while there is no detectable odor since the liquid latex is a water base, particles of rubber are being emitted into the atmosphere creating air-pollution and is demanding a method for removing this so called "nuisance."*

*We want to call your attention to the fact that any filter inserted in front of the exhaust fan, as a baffle, is impracticable since the particles would immediately clog the filter.*

*Can you suggest any kind of a device to remove or eliminate a great part of these particles from reaching the outer air?*

*W.G.,*
*New York*

**Answer:**

It is unfortunate that the questioner did not indicate whether he was primarily interested in modifications to existing booths in the field or redesign of their present product for future sales purposes. In any event, the following types of equipment could be utilized in solving this problem:

(1) *A wet back curtain in the spray booth.* Such equipment is presently designed by the DeVilbiss Company, the Research Products Filter Co. of Madison, Wis. and others. This is merely a curtain of falling water which entraps

*(Please turn to page 55)*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Source: *American Society of Heating, Refrigeration and Air Conditioning Engineers, Dept. AE-11, 234 5th Avenue, New York 1.*

## Staplex Bulletin

● A four-page bulletin describing manufacturer's new portable high-volume air sampler, recommended filters and holders.

Source: *Staplex Co., Air Sampler Division, Dept. AE-11, 777 Fifth Ave., Brooklyn, N. Y.*


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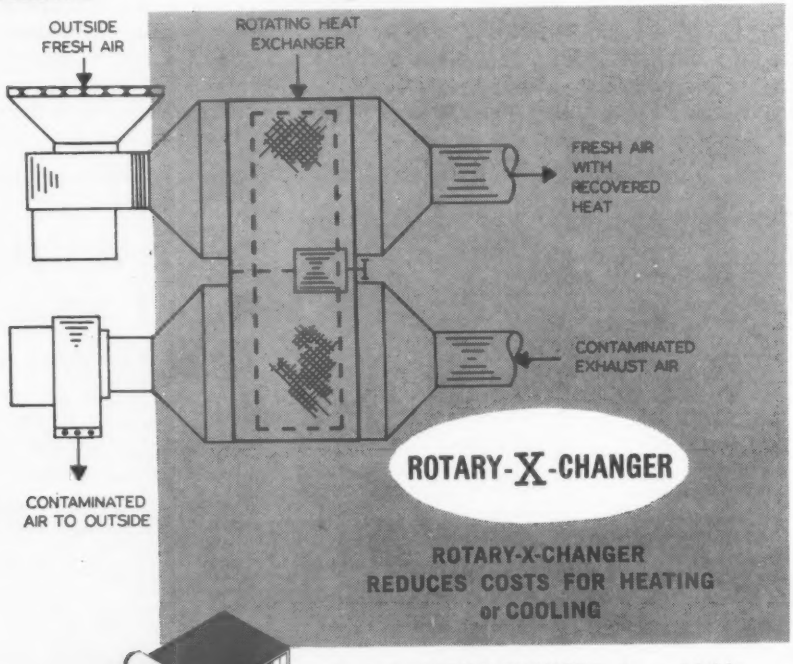


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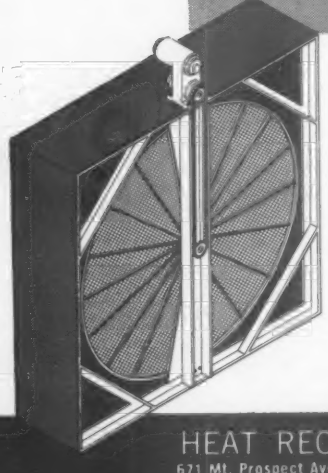

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## Cooling Tower Bulletin

● A four-page, illustrated description of manufacturer's line of centrifugal fan cooling towers. Charts provide operating and dimensional data.

Source: *Halstead & Mitchell Co., Dept. AE-11, Bessemer Bldg., Pittsburgh 22.*

## New Methods of Heating Buildings

● A report of the research correlation conference conducted by the Building Research Institute, November, 1959. Topics considered include: *Energy and Fuels for Future Heating and Power Systems, New Air Heating Methods, Hydronic Heating, Radiant Systems for Heating, New Electric Heating Systems, The Future of Solar Heating* and *Future Heating Needs.* 138 pages. Price: $5.

Source: *Building Research Institute, 2101 Constitution Ave., Washington 25, D.C.*

## Air Pollution Field Test Apparatus Booklet

● A twenty-page booklet dealing with the methods of taking samplings. Chapters include *General Instructions, Atmospheric Sampling, Estimation of Gaseous Pollutants, Detection of Particulate Pollutants,* and *Maintenance.* Clearly illustrated photographs, formulas and charts. Last three pages devoted to manufacturer's products.

Source: *Central Scientific Co., Dept. AE-11, 1700 W. Irving Pk. Rd., Chicago 13.* Booklet 20770.

## *AE Reprints*

## Primer on Factory Ventilation

● A comprehensive discussion of basic make-up air systems, factors influencing sizing of make-up air units, types of equipment, temperature controls, filtering, air distribution, system numbering and cost factors involved. Sixteen pages, illustrated. Price 75¢.

Source: *Technical Literature Division, Air Engineering, 450 W. Fort, Detroit 26,* or use convenient card in Communication Center.

## Ultraviolet . . .

*(Continued from page 45)*

meet the crisis created by the flu, a new high-output Germicidal tube was developed by the Westinghouse Electric Corporation. The lamp was just 18 in. long, with two lamp holders, and would accommodate any heating or cooling duct work, including room size air conditioners. Its special glass envelope was designed to permit the generation of controlled quantities of ozone to assist deodorization. The G10T5½H lamp was further designed to perform at its maximum in an air stream.

The G10T5½H STERILAMP® is inserted, out of view, as shown in Fig. 3, in the return air duct of the forced air heating or cooling system. The lamp is located in the center of the longest straight section of return air duct before the filter.

The effectiveness of the lamp varies slightly depending upon the cross-sectional dimensions of the duct where the lamp is located, the length of straight section of duct on either side of the lamp and the rated cubic feet per minute (cfm) of the system. With this information, the number of lamps required for an 80 percent kill of micro-organisms may be calculated from the following formula:

$$\text{Lamps required} = \frac{\text{Cfm}}{\text{VDW}^{*} \times \text{Corrected Lamp Output}}$$

Rated cfm is supplied by the manufacturer of the heating or cooling equipment. The corrected lamp output may be found from Fig. 4. Air velocity to be used in this figure is arrived at by multiplying the duct height by its width (both in feet) and dividing this product into the cfm. It may be noted in Fig. 4 that the lamp output, like that of the G36T6 lamp, for large systems, is affected by the ambient temperature of the air. Unless other knowledge is available 70°F should be used.

The volume of air disinfected per watt of ultraviolet of VDW is determined in Fig. 5. It should be noted that the duct length will depend upon where the lamp is mounted and will be the length of straight duct on either side of the lamp. With the above calculations, the number of lamps is determined for an 80 percent kill of micro-organisms.

What, it may be asked, is the value of this 80 percent kill of micro-organisms in the home, office or schoolroom?

Unfortunately, we can only guess at the answer. The first drawback to gathering statistical data is the recency of a suitable lamp for small air conditioning application. Comparative data are required for years before a decision can be drawn or a correlation made. In addition, each family lives under

**VDW is the volume in cfm of air disinfected to 90 percent by one watt of 2537 A radiation.*

*(Please turn to following page)*


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## Ultraviolet . . .

*(Continued from preceding page)*

widely differing conditions and susceptibility to respiratory infections varies from year to year.

It is important to note that one long term study indicates that children between one and six can be expected to have eight colds per year, with kindergarten children receiving as many as twelve. Incidence then decreases each year. The mother may expect five attacks per year; the father four. However, it seems logical to deduce that a reduction in the number of airborne organisms should reduce the incidence of respiratory diseases.

### Next Month

Next month, the last of this series takes up application of ultraviolet lights in the meat and food industry, and in the generation of negative ions. ▲▲

*Use Communications Center, page 35, for requesting more information about articles, advertised products, literature, and for comments about any of the editorial material in this issue of* AIR ENGINEERING.

*If you wish to contact manufacturers directly, street addresses are given. But please mention you saw it in* AIR ENGINEERING.

## Sanding Machine Dust

*(Continued from page 49)*

making a change of direction to enter the hood. This means loss of much efficiency.

By locating hoods between the drums, cuttings need travel through an arc of only 90°. They proceed through a considerable part of that arc from the initial impetus given by the drum. Therefore, they are received by the hoods in the natural direction of throw.

Long experience has shown that efficiency is definitely impaired at different woodworking machines when cutting elements are so tightly enclosed that pull of air through the exhaust system induces a partial vacuum around them.

In different instances, therefore, machine designers have carefully made provision for adequate inflow of air, to properly eliminate any restriction imposed by such vacuum.

As a case in point, provision for ready inflow of air to the enclosure within which a woodworking planer head revolves has sometimes been made by providing the machine chipbreaker with a series of holes. Through these holes, air may enter readily, providing a boosting instead of a restrictive effect to shavings withdrawal by the exhaust system.

*(Please turn to page 58)*

## Heat Recovery . . .

*(Continued from page 42)*

tain a constant temperature on the outside air side of the exchanger; the other, to spill excess heated outside air and blend outside air to maintain a constant make-up air temperature.

In Fig. 11, we have chosen the latter method. Fig. 12 shows graphically the rise in outside air temperature in a duct bringing make-up air to a building, if no attempt at control were made. Fig. 13 shows the volumes of outside air which must be introduced downstream of the heat exchanger at rising outside air temperature, and also the point where heated outside air must be spilled to prevent a temperature rise above the control point

This installation is contemplated in an area which has a die cast department with an adjacent painting department. The exhaust air will relieve the smoke from the metal casting operation and the outside air supply will reduce the building negative pressure caused by the large volume of air exhausted from the paint booths.

While the cost of this equipment is rather high, the potential savings in steam seems to justify the expense, on the premise that a heating system and an exhaust system of some form is necessary. The cost of operating a conventional heating system would be direct savings times the efficiency factor of the exchanger. Thus:

Cost of equipment: $20,472

Cost of heating 50,000 cfm of make-up air =

$$\frac{1.08 \times 50{,}000 \times (70° - 35°) \times \$1.25}{1{,}000{,}000} = 2.35/\text{hr.}$$

$\$2.35 \times 16$ hrs. $\times$ 193 days $= \$6{,}504.80$/yr – Cost of Steam

$\$6{,}504.80 \times 80$ percent $= \$5{,}203.84$/yr. – Steam savings by heat exchanger method.

On this basis the installation will pay out in approximately four years.

### TO SUM UP

The examples used are typical of the approaches we have made to many conservation projects The principles applied are:

(1) Complete evaluation of production process as compared to concentrating on each unit.
(2) Heating make-up air by blending hot uncontaminated air.
(3) Heating make-up air by blending slightly contaminated air and controlling dilution rate to hold safe limits.
(4) Routing heat from one process to another.
(5) Heat exchanging.

*(Please turn to page 58)*

## Q & A . . .

*(Continued from page 51)*

any overspray prior to discharge into the atmosphere. It is commonly used on enamel and lacquer paint spraying product operations.

(2) *Automatic roll-up filter media.* This is simply material which is intermittently or continually fed across the exit gas stream so it will automatically present a fresh filter surface to prevent clogging and possible back draft conditions. Such equipment is available from the American Air Filter Co, Louisville, Kentucky.

(3) *Simple wet washer.* This can take the form of many of the basic scrubbing systems which can be added to an existing device, such as is commonly manufactured by Ducon, American Air Filter, Arco, Research Cottrell, etc.

(4) *Electrostatic paint spraying.* Not enough details were given on the actual processing involved here, but electrostatic painting has been used for water-based paints to cut down measurably on any overspray. I am not acquainted with any firm producing such equipment on a production basis, although Ford Motor Co. and another company in Cleveland, Ohio were experimenting on its use.

(5) *Direct flame incineration.* The products could always be directed through a specially designed combustion chamber where the effluent could be rendered nuisance free by high temperature destruction.

---

### Desires Data On Fluoride Differences

*How do the fluorides that affect the teeth of cattle differ from the fluorides that are being so strongly pushed for addition to drinking water to preserve human teeth?*

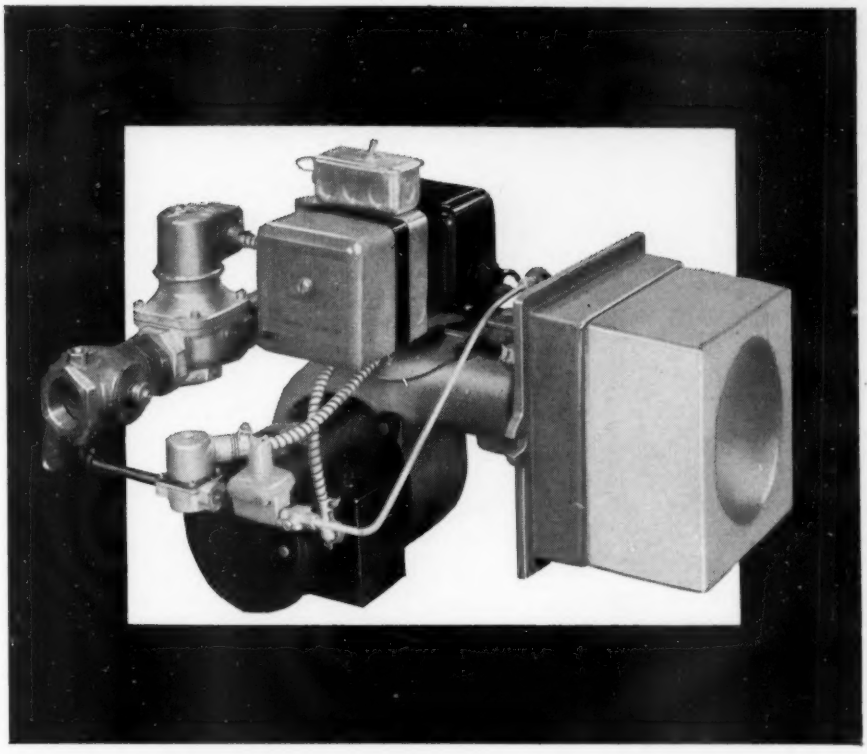
*P.B.M.*
*Philadelphia, Pa.*

**Answer:**

The active material in fluoridation of water for dental benefits and in fluorosis in cattle is the same, fluoride ion or F.

Sodium fluoride, sodium fluosilicate, and hydrofluosilicic acid are used in fluoridation of water supply for dental benefits. Concentrations of approximately one ppm (parts fluoride ion per a million parts water) are used. In cattle fluorosis, fluoride ion may come from:

*(Please turn to following page)*

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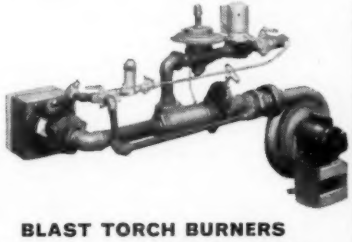

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# Q & A . . .

*(Continued from preceding page)*

(a) Natural contamination of forage

(b) Industrial emissions and contaminations

(c) Phosphate rock mineral supplements to the diet of the cattle.

Concentrations causing dental damage and fluorosis in cattle have not been precisely determined but are of the magnitude of 50 ppm to 100 ppm and higher. Cows, however, are more susceptible to fluoride than most animals.

Contaminations on cattle forage from the various sources listed may be any of the compounds listed for use in water fluoridation as well as a number of complex mineral fluorides and hydrogen fluoride.

The fluoride ion used in water fluoridation is the same fluoride ion active in causing cattle fluorosis and dental damage. The concentrations, however, are vastly different.

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## Effects of Air Cleaners On Staphylococcus Aureus

*What information do you have on the effect of electrostatic air cleaners on the size and locomotion on Staphylococcus Aureus?*

*E.B.R.*
*Conn.*

**Answer:**

Staphylococcus Aureus is a spherical shaped organism, grouping in typical clusters, like grapes. The average size is about 0.8 microns (range 0.4 to 1.2 microns). It has no means of propulsion either in liquid or air. It probably occurs in air as droplet nuclei or attached to air floated minute particles of dust, lint, or skin. The droplets are produced by the atomization of respiratory secretions from talking, sneezing, laughing or coughing. The droplets evaporate almost instantly, leaving nuclei of one or more bacteria coated with dried organic material.

Convection currents tend to keep room air in constant motion, which cause droplet nuclei and small bacteria bearing dust particles to remain in a state of continuous suspension. In general it has been shown (1) that fiber air filters with an efficiency of 90% or

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higher by the Dioctyl Phthalate Test Smoke method or the National Bureau of Standard discoloration method using atmospheric dust will have an efficiency of about 90-99% on bacterial droplet nuclei containing Staphylococcus Aureus and an efficiency of 99 to 100% on dust borne bacteria. Tests (2) have been reported on certain electronic air cleaners indicating efficiencies of 94% and higher by the NBS test method on atmospheric dust.

### Electrostatic Cleaners

Electrostatic cleaners have also been tested against bacteria. One test (2) reported an efficiency of 98% by count on a spherical shaped organism 0.5 to 0.7 microns. Another investigator (3) who made a large number of tests on two types of electrostatic precipitators, reports efficiencies of 89-97% on bacteria Serratia Indica (0.5 to 1. microns). This investigator recommends an efficient after-filter of fiber glass.

Inasmuch as there are a large number of electrostatic air cleaners on the market, efficiencies of collection for one electrostatic cleaner will not apply necessarily to other electrostatic cleaners. Design details such as velocities through plates, distance between plates, depth of plates, voltages used, use of adhesive coated plates or dry plates, the use of pre-filters or after-filters and other factors can affect collection efficiencies over a wide range.

The fiber filter air cleaner improves in collection efficiency with loading; however, the air flow is decreased and resistance to flow increased. The efficiency of the electrostatic, however, may decrease with loading, and if it is allowed to operate without cleaning it may "blow by" clumps of dust from the plates. On a critical

*(Please turn to page 59)*

## Chemical Ventilation . . .

*(Continued from page 37)*

used cartridge may be performed within the hood. A control velocity of 100 fpm usually provides desired control. This hood design will contain any drippage which may occur during filter replacement. Washing of the filter casing with solvents may be performed within hood with satisfactory control. ▲▲


New DAY "RJ" Dust Filter

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only 3 moving parts

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## Sanding Machine Dust . . .

*(Continued from page 54)*

### Avoiding Restriction of Vacuum Effect

In the case of the endless-bed sanders under consideration, adequate provision for air inflow has been made by covering the different sander drums (between the exhaust hoods) with framed panels, incorporating expanded metal in the center.

These mesh-type covers adequately protect the drums from any falling debris, and insure adequate physical safety for operators, yet allow a free inflow of air to boost sander dust upward through the exhaust pipes. ▲▲

## Heat Recovery . . .

*(Continued from page 54)*

(6) Transfer of heated air from over heated areas to cold areas directly with inexpensive fans.

We have seen large, costly make-up air heating units installed in other plants, right near a source of usable heat from production equipment. With these heat recovery suggestions, it should be possible to reduce plant heating bills substantially, without a commensurate increase in make-up air cost. ▲▲

## Project Mercury . . .

*(Continued from page 32)*

troller. The step controller has its bulb in the common chiller supply header, and controls chilled water temperature by controlling the refrigerant solenoid valves on the four chillers (two valves per chiller). The chillers have suction pressure controlled cylinder unloading valves which act independently of each other. Two cooling tower fans are controlled by a thermostat with its bulb in the common leaving water line. The pneumatic thermostat actuates two P.E. switches between 77° and 85°.

Load calculations provide for fresh air 78 tons, conduction 26 tons, electrical equipment 23 tons, and lighting 15 tons. Outdoor design conditions are 95° DB and 78° WB.

Installation cost of the air handling and air conditioning system, including pneumatic controls, was approximately $500 per ton of refrigeration. Total costs for the entire facility averaged approximately $14 per sq. ft.

As we progress into the "Space Age", we will have to abandon our previously accepted cleanliness, filtering, and conditioning levels, and meet new performance requirements through achievement of a high degree of perfection in environmental control. ▲▲


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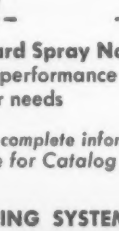

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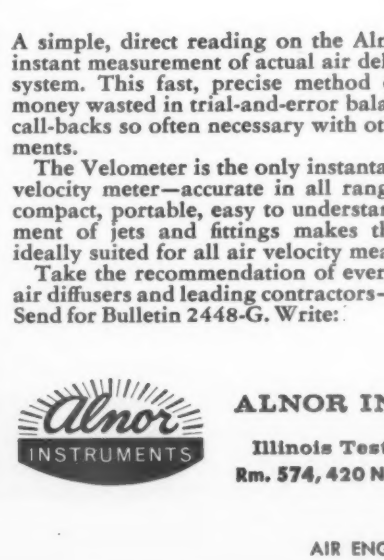

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## Q & A . . .

(Continued from page 57)

installation such as an operating room, it is therefore recommended that an efficient after-filter be provided to take care of dust that may blow off the plates if the collector gets loaded.

Electrostatic cleaners should be set up on regular plate cleaning and adhesive coating schedule to maintain top efficiency. Semi-automatic cleaning devices are available which greatly reduce the time of cleaning.

### REFERENCES


1. Allen, Henry F., M.D., Air Hygiene for Hospitals, *Journal American Medical Association*, Feb. 7, 1959, Vol. 169, pp. 553-559.
2. Silverman, L. and Dennis, R., Removal of Air Borne Particulates and Allergens by a Portable Electrostatic Precipitator. *Air Conditioning, Heating and Ventilating*, Dec., 1956, pp. 75-79.
3. Decker, H. M., et. al. Removal of Bacteria and Bacteriophage from Air by Electrostatic Precipitation and Spun Glass Filter Pads. *Heating, Piping and Air Conditioning*, Am. Soc. Heating and Ventilating Engineers, J., 23:125 Oct. 1951.


### ERRATA

In our September article *Electric Furnace Emission Control*, page 54, please note the following changes: In the second paragraph, third column, which describes the Pangborn Electric Furnace Exhaust Hood design, reference should be to Figures 3, 4 and 5 instead of 1 and 2. Also, the caption under Figure 5, the 9 ft. diameter furnace in the center was operating at the time photo was taken.

### COMPLAINT$

With this issue we are discontinuing our Complaint$ column, as we feel it does not serve the reader in helping him solve his own air pollution problems. We would appreciate receiving comments upon the column and our decision to discontinue it. For this purpose, please use the Communications Center card on page 35.

*Use Communications Center, page 35, for requesting more information about articles, advertised products, literature, and for comments about any of the editorial material in this issue of* AIR ENGINEERING.


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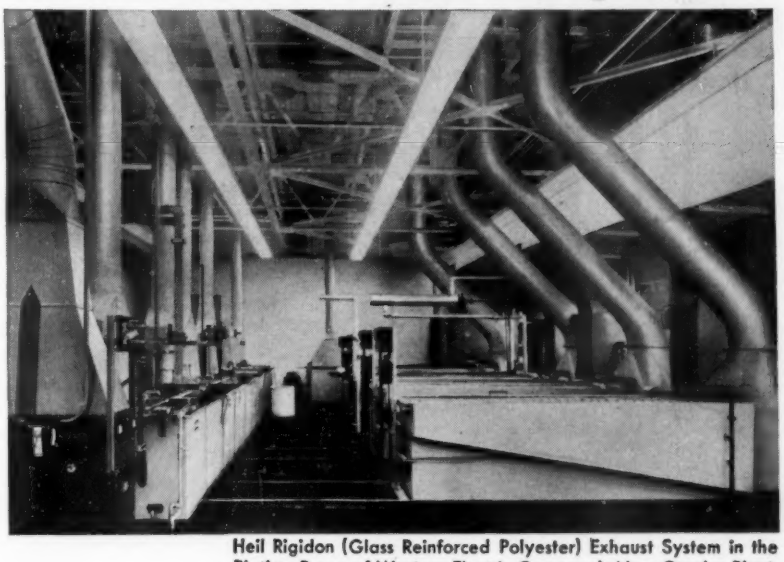
# PLASTIC VENTILATING SYSTEM at *Western Electric* plant



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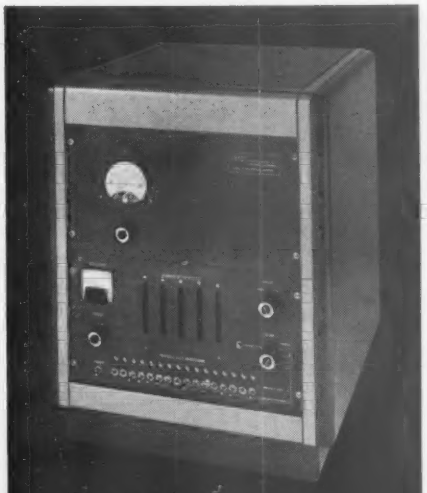

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